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contributor to the internal pressure of the tail is a considerable amount of tellurar flowing plasma. In soldtion to the expected internal field pressure. Magnetic field veriance analyses provide quantitative swidence for field-line draping around the boundary of the tail and also show that internal tail-field

the test and also show that internal tail-field transverse vertailons occur. We suggest that the Jovian tail has a quesi-periodically variable width (resembling a string of sausages) on a very long length socia, tens of thousands of Jupiter radii, due to the influence of the set 23-day radial variation of the solar vind pressure. The tail is also apparently filesentary to some degree. (Jupiter, magnetic fields, plasmas, plasma vaves),

J. Gaophys. Res., Blue, Paper JA1016

3745 Magnetospheric Configuration (Jupiter) CHARGED PARTICLE DISTRIBUTIONS IN JUPITER'S

Particles and Fields-

Magnetosphere

Vol. 64, No. 28, Pages 449-456

sents the data typically to within a factor of 2<sup>±1</sup>, except where time variations, neglected in the model, are known to be significant. Several practical applications of the model to spacecraft near Jupiter are illustrated with sample results from radiation smalyses and electrostatic charging calculations. (Hagostuphers of Jupiter, Spacecraft Charging, Radiation Effects).

J. Geophys. Ros., Blue, Paper 3A0932

STRUCTURE AND OTHER PROPERTYS OF JUPITE'S DISTANT MAGNETOTATI.

A. J. Lopping (Goddard Space Flight Center, Laboratory for Extraterreatrial Physics, Greenbelt, MD 20771), M. D. Desch, L. W. Elein, E. C. Sittler, Jr., J. D.

Sullivan, M. S. Kurth and K. W. Behannon
Analyses using data from the Plassa Mave, Plassa Science, Planstary Radio Astronosy and Magnetometer experiments onboard Yoyagar 2 covering the period October 1980 to August 1981 are shown to provide compelling evidence for, and characteristics of, a jovian agreatotal extending at least to 9,000 Juvian radii from the planet. Yoyagar 1 angustic field and nave data from the planet. Yoyagar angustic field and nave data from the planet. Yoyagar 1 angustic field and nave data from the planet. Yoyagar 1 angustic field and nave data from the planet, the provided that department of the same time period indicate that it was very unlikely that the distant down that apaceoratt. During approximately (25-day) periodic sightings of the tail by Yoyagar 2 the magnetic field tanded to point radially towards or many from Jupiter. indicating of the structure observed near the planet, as in the earth's case. This periodicity, along with various properties of the solar wind that time, indicates that the tail is apparently influenced by recurrent solar wind features. Annualous magnetic fields, not aligned with the nominal tail axis, also exist within the tail, especially in the low density, feature is a second to the product of the spaceoraft. On a finer scale the field increases across the inhound boundary as aspected for a quasi-standy as all actual contributor to the internal pressure of the tail is a considerable assount of tail, and flowing planes. In THE 23 ZONAL HARMONIC MODEL OF SATURN'S MAGNETIC FIELD: ANALYSES AND IMPLICATIONS

H. H. Acuña (HASA/Oodderd Space Flight Conter, Laboratory for Extratercatrial Physics, Greenbelt, Maryland 20771) J. E. P. Concerney and H. F. Hosm.

The planetary magnetic field of Saturn has been studied by the Spacecraft Pioneer 11 in 1979, Yoyager 1 in 1980 and Yoyager 2 in 1981. The field is found to be primarily dipolar and axially coincident with the rotation axis but with significant quadrupola and ogtupola moments. The barsonic terms are at = 21533 nT, g2 = 1642 nT and g3 = 2783 nT. This model field (2,) in conjunction with a model for an equatorial ring current, represents are data on charged partials absorption by satellites and rings within 8 R, of the planet. Bosever, this axisymmetric model fails to radiation (SIR) or Saturn's Electratetic Biocharges (SEB). This enigms of Saturn's Electratetic Biocharges (SEB). This enigms of Saturn's magnetophere remains unacolved in spite of extensive reconsideration of all evilable data bearing on this issue. (Saturn, magnetic fields, Yoyagar).

J. Coophys. Res., Blue, Paper 3A0699

STRS Megnetospheric configuration
CURRENTS IN EATURN'S MAGNETOSPHERE
J. E. P. Connerney, H. H. Acudia, N. F. Mess (MASA/
Goddard Space Flight Center, Laboratory for Extraterrestrial Physics, Greenbelt, Maryland 20771)
A model of Saturn's augmentespheric magnetic field is
obtained from the Voyager 1 and 2 observations. A
representation consisting of the 2, monal harmonic model
of Saturn's planetary magnetic field together with an
explicit model of the equatorial ring current fits the
observations wall within r (20 H. The aspacehydrodynamic momentum equation is used to obtain, from the
and mass density at redial diatences of 8 < r < 16 B.
These estimates are generally consistent with those
obtained by the Fincer 11 and Voyager plasms investigations. The Voyager i observations suggest the presence
of a global fital aligned current of r to A flowing
into the (southern) surveys home: in the swening sector,
found in the Voyager 2 observations obtained a year
later. (Sirkeland currents, field aligned currents,
sturn's augmentencher, such a field aligned currents,
Stater's augmentencher, such a field a

5745 Magnetospheric configuration
CURRENTS IN SATURE'S MAGNETOSPHERE
J. S. P. Connergey, M. H. Acufas, H. F. Hess (MASA/
Coddard Space Flight Canter, Laboratory for Extratorrestrial Physics, Crespbelt, Karyland 20771)
A model of Sature's magnetospheric magnetic field is
obtained from the Voyager 1 and 2 observations, A
representation consisting of the L zonal hermonic model
of Sature's planetary magnetic field together with an
explicit model of the equatorial ring current fits the
observations well within r C.20 R. The magnetohydrodynamic momentum equation is used to obtain, from the
magnetic field model; estimates of the planes pressure
and meas density at redial distances of S c r ( 16 s.
These estimates are generally consistent with those
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later; (Sh'keland ourcents, field aligned aurrents,
Saturn's magnetosphere, amquetic-(faild),
J. Gangloys, Sac, Sine, Paper's 20097-20097.

6755 Plasma Instabilities OBSERVATIONS OF OGO-HALF CYCLOTRON NAMENICO IN A SHELL-MAXWELLIAN LABORATORY PLASMA. J. M. Urrutia (Physics Department, whiterity California, 4024), California, 4024), California, 4024), California, 4024, California, Los Angeles, California, 90281, C.R. L. Stenzel
Loss-cone distributions have, until reschi, a considered the prime cause of ode-half cycled harmonic metissions. Based on one observation, it has been proposed that shell-facellia distributions are also unstable to these major oxporfement where a shell-Haxwellia distributions are also unstable to the major oxporfement where a shell-Haxwellia distribution are also unstable to the major oxporfement where a shell-Haxwellia distribution oxporfement where a shell-Haxwellia distribution oxporfement where a shell-Haxwellia distribution of shell and the control of the plasts ender shell showed that the ownissions fall within the plast shell harmonic branches (Bornstein waves). Int was disported in an addition of the plasts are shell as the complete of loss-come theory for the support hybrid branch. In addition, the state of the predictions of loss-come theory for the plasts of the plasts are shell below the instability fraguency the system below as as if it were composed of shell electronly. Present theories do not account for use findings.

J. Geophys, Ross., Blue, Paper 340949

5775 Trapped Particles ENERGETIC ATOMIC AND MOLECULAR 1085 IN SUITS'S

Brown G. Gloschier, W.I. Auford
We present observations and animals of its ofrion, energy spontrs and special distribution,
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getto ions (60.2 Maylanaleon) in Sansa's main
cutation of AB B. Our results are based what
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the low energy particle telescope (1771, and
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very soft (y ~ h-7) with an apparent confirm
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that the sansystic Ma. Case demonstration,
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vances in the implementation of on-line flood forecasting systems. During the quadrennial period, fundamental advances were achieved n applying systems theory and state-estimation to on-line hydrological forecasting. These advances include model structure dentification and parameter estimation, as well as embedding hydrological models within a state-space framework capable of the necessary feedback to incorporate on-line lata. Some of the most important work has been in the area of parameter identifiability for conceptual hydrological models. Results indicate that the available data are insufficient hat the available data are insufficient to estimate all the parameters accurately—ei-

The quadrennium 1979-1982 produced

undwater hydrology, as well as important

ds toward a more scientific basis for engi-

One of the most significant areas to emerge

The work over the last quadrennium can

tical analysis of parameters and inputs that

proaches including spectral analysis and

special sessions have been held at national

and international symposia to disseminate re-

sults. While significant results have been ob-

fundamental theory that relates the scale of

the process to equation formulation in a man-

ner that incorporates the heterogeneity of the

medium. This work is critical to the ground-

During the last quadrennium, the aware-

ardous wastes—especially chemical wastes—

ollected and attempts to model contaminan

transport are made, it is clear that current

least two areas: (1) relationships among mi-

models and procedures are insufficient in at

croscale heterogeneity, numerical model representation and data collection are not well

oordinated at the landfill site scale, and (2)

understanding of the chemical processes (for

example, adsorption or desorption), biologi-

cal processes (for example, degradation of

chlorinated hydrocarbons), or physical pro-

cesses (for example, relative conductivities or

mixing properties of multipliase organics in

Fundamental work, including both labora-

tory and field analyses, is required if progress

pabilities of groundwater transport models.

the area of engineering hydrology are ad-

In surface water hydrology, progress has been made on several fronts. Most notable in

saturated media) is incomplete.

ness of groundwater contamination from haz-

has grown. As data from waste sites are being

water transport problem.

tained, much work remains in developing

ther the models need to be simplified or additional components of the hydrological budget need to be measured. The implementation of on-line flood alert systems, coordinated by the U.S. National Weather Service, has grown by a factor of ten during the quadrennium, with the demand for such systems growing far faster than state and federal agencies can fulfill. The National Weather Service is leading the way in this important area. The most notable aspect is the desire of field hydrologists to incorporate recent research results into these systems. Internationally, this area is gaining in importance, as can be seen from recent conferences de-

roted to flood forecasting (e.g., IAHS, 1980). The current quadrennium saw consolida-tion rather than significant developments in the area of statistical hydrology. The last quadrennium ended with a conference on hydrologic data networks. Langbein (1979), in summarizing the conference, recommended five areas where the research results could be extion problems. These recommendations inuded: data transfer among stations (regionalization), broaden the scope so as to apply techniques common to surface water to other

hydrological areas, carry out audits to see how networks fulfill current or modified objectives, investigate how data needs vary with water management objectives, and improve coordination among various data networks.

The general area of regionalization, as applied to flood frequency, has received more attention during the current quadrennium than other topics. The concern has been two-fold: (1) development of statistical models and procedures that better represent flood data and (2) development of robust estimates using regional data in a hydrologically and statistically responsible manner. In the research community, there is wide belief that current operational methods should be im-

Fundamental research into flow generation and basin structure has started to pull together work in widely varying areas: geomorphology, soil physics, surface hydrology, and statistical hydrology. A unifying theory for hydrologic responses at varying basin scales has not yet been developed; work during the last quadrennium focused upon various issues including 1) the basin response and flood statistics based upon its geomorphological struc-ture, (2) soil variability and runoff variability, and (8) role of macropore flow, interflow, and contributing area surface runoff in the flow response. It is crucial that adequate and detailed data be available so that theories concerning runoff generation can be adequately

In hydrology, the long-term trend appears to be a bifurcation of the field into scientific hydrology and engineering hydrology. Exciting developments in scientific hydrology will be made in all areas: equation formulation for porous media flow, advances in our understanding of hydrological processes at various scales, and improved statistical representation of hydrological processes in time and space. One hopes that equally exciting developments will occur in engineering hydrology. At present, one sees some very creative applications of research results-especially in the area of groundwater modeling. It is important for the engineering side of hydrology to understand recent developments and to apply them where appropriate; likewise it is important for those in hydrologic research to understand the problem faced by field and engineering hydrologists.

#### References

IAHS, Hydrological forecasting symposium, IAHS-AISH Publ., 129, 571, 1980. Langbein, W. G., Overview of convergence on hydrologic data needs, Water Res. Res., 15, 1867-1871, 1979.

## Contents: IUGG Quadrennial Report Hydrology

Hydrology 1979-1982, E. F. Wood Flood Frequency Analysis: A Review of 1979-1982, N. P. Greis Surface Water Hydrology: On-Line Estima-

tion, S. Sorooshian is to be made at improving the predictive capabilities of groundwater transport models.

Surface Water Hydrology: Runoff Generation and Basin Structure, K. Beven Urban Hydrology, J. W. Delleur Progress in Hydrodynamic Modeling: Review of U.S. Contributions, 1979–1982, D. R.

Unsaturated Soil Water Flow, R. E. Smith Ground Water: A Review, J. D. Bredehoeft Research on Snow and Ice, R. G. Barry

## Geodesy 1979-1982

Bernard H. Chovitz MD 20852

The growing interaction of geodesy with its kindred disciplines, oceanography and tectonophysics, may have been the most significant trend in geodetic activity during this past quadrennium. Geodetic observing systems are now capable of measuring so much more precisely (to the centimeter level) and over such a broader extent (like the oceans), that their results add materially to knowledge of crusta and mantle structure, of ocean bottom relief, and of oceanic circulation. Especially impor-tant is the application of precise, repetitive geodetic measurements to the detection and analysis of time-varying effects. Examples are the utilization of altimeter data to yield ocean boundary current changes, and of radio interferometry and laser ranging to systematically monitor polar motion, earth rotation,

There has also been an increased awareness of the value of classical observations of lended and applied to important data acquisiludge. These recommend data acquisiing, a large effort has been made to exposesystematic aberrations so that the intrinsic precision of the measurements can be properly exploited.

A perusal of the presentations at the semi-annual meetings of the American Geophysical Union over the past 4 years indicates not only that a major portion of the geodetic sessions has been devoted to these topics, but that many papers in the oceanography and tectonophysics sessions employ geodetic theory and observations to an extent never evident before.

The traditional tools for making geodetic observations are in the process of giving way to more rapid, precise (and complicated) devices. Inertial surveying systems have already yielded operational results, and the Global ing System is on the verge of doing likewise. The report for the next quadrenni quences of this incipient revolution in geodet-ic surveying methods.

In contrast to the period 1975-1978 during which Geos 3, Lageos, and Seasat were launched, no comparable satellites became operational within the period under review. This circumstance, however unwelcome, forced scientists to thoroughly scrutinize the data recently amassed. Visible examples of this emphasis on analysis were two special is sues of the Journal of Geophysical Research, Vol. 84 (B8), June 30, 1979, on Geos 3; and Vol. 87 (C5), April 30, 1982, on Seasar.

During the past 4 years, the American geo-detic community benefited from the guidance provided by several committees of the National Research Council, U.S. National Academy of Sciences, especially the Committee on Geodesy. The work of these committees is delineated in a series of reports which furnishes an excellent panorama of the geodetic interests prevalent today in the United States. These publications by the National Academy of Sciences, Washington, D.C., are: Impact of Technology on Geophysics, Geophysics Study Committee (1979); Applications of a Dedicated Gravitational Satellite Mission, Committee on Gendesy (1979); Need for a Multipurpose Cadas tre. Committee on Geodesy (1980): Geodetic Research and Development in the National Ocean Survey, Committee on Geodesy (1980): Foleral Surveying and Mapping: An Organizational Review, Committee on Geodesy (1980); Geodetic Monitoring of Tectonic Deformation—Toward a Strategy, Committee on Geodesy/Committee on Seismology (1981); Modernization of the Public Land Survey System, Committee on Integrated Land Data Mapping (1982).

Special symposia on geodetic topics held in the United States for the period 1979-1982 were: Second International Geodetic Symposium on Satellite Doppler Positioning, Austin. Tex. (January 22-26, 1979); Radio Interferometric Techniques for Geodesy, Westford, Mass. (June 19-21, 1979); Ninth International Symposium on Earth Tides, New York, N.Y. (August 17-26, 1981): Third International Geodetic Symposium on Satellite Doppler Positioning, Las Cruces, N.M. (February 8-12, 1982).

One reason for this comparatively small number compared to the two previous quadrennia is that other countries have been sponsoring more international meetings. U.S. scientists have participated actively in, and U.S. organizations have cosponsored, many

symposia taking place elsewhere. However, the chief indication of the contin ued vitality of geodesy in the United States is not displayed by conference activities but by the evidence of theoretical and practical results as manifested in the following reports on specific accomplishments, and the accompanying bibliographical records. These cer-tainly are not complete. The proliferation of geodetic pursuits and applications has ren-dered more difficult than ever the task of encompassing within these reviews the entire field of endeavor. Following the precedent of the editors of the previous two quadrennial reports, I apologize for inadvertent omis-

## Contents: IUGG Quadrennial Report

Introduction to the Report on Geodesy, B. H. Control Surveys, J. G. Gergen and C. T. Wha-

Gravimetry, L. E. Wilcox and D. M. Scheibe Earth Tides, C. C. Goad Geodetic Theory, C. Jekeli Crustal Movement, L. Brown and R. Reilinger Status of the Geopotential, F. J. Lerch Radio Interferometry, W. E. Carter Polar Motion and Earth Rotation, B. D. Tapley Satellite Altimetry, J. G. Marsh Satellite Positioning, R. W. Hill New Techniques, V. L. Pisacane

## Seismology 1979-1982

Michael A. Chinnery NOAA, National Geophysical Data Center.

The years 1979 to 1982 have been marked by a continuing expansion and development scismology in the United States. In this inroduction, we summarize some of the highlights of this period as a prelude to the more. detailed papers that follow. These papers cover improvements in our understanding of

### U.S. National Report to IUGG 1979--1982

Eas is periodically publishing the 13 overviews appearing in the U.S. National Report to the International Union of Geodesy and Geophysics 1979—1982. The U.S. National Report was published by AGU on behalf of the U.S. National Commitee in four extra issues of Reviews of Geophysics and Space Physics (RCSP). The discipline overviews appearing here were published with their associated papers (see Contents list at the end of the each overview).

ubscribera to RGSP will automatically receive Substribers to KOSP issues containing the U.S. National Report, which were malled in June 1983. The four regular issues of RGSP are appearing as usual in February, May, August, and November. Those who do not subscribe to RGSP can still obtain the entire U.S. National Reports of the subscribe as a subscribe to RGSP. Report by entering a subscription to RGSP. In addition, the report of each discipline is automatically mailed separately to those members of AGU for whom that discipline is their primary AGU for whom that discipline is their primary AGU section affiliation; this separate distribution is made possible by grants from the Defense Mapping Agency, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, National Science Foundation, Office of Naval Research, and U.S. Geological Survey.

earth processes together with improvements in the various geophysical techniques available to study them.

Perhaps the most traditional area of seismology is the study of the structure of the earth's interior, though recent developments are following most untraditional directions. Highlights of this area include significant new information on lateral heterogeneity, anisotropy, and the mechanisms of scattering and attenuation. Using a variety of techniques, we are beginning to identify the regions of the earth that are the most beterogeneous and to characterize the heterogeneity in those regions. The upper mantle has long been known to contain lateral variations, particu larly in the appermost part. New data are beginning to suggest substantial beterogeneity in the transition region between 400 and 670 km depth. In addition, more evidence is confirming lateral variations in the lower 200 km of the mantle. Attempts to relate these various heterogeneities to tectonic processes at the earth's surface and motions in the earth's core are continuing.

Attempts to establish a reference earth model that is in some sense a best ht to a wide variety of seismological data are approaching completion. An interesting conclusion of this work was that the overall fit can be improved by the inclusion of elastic anisotropy in the upper 220 km of the earth's mantle. This anisotropy is transverse, with a vertical axis of symmetry. Regional studies have often indicated some degree of both transverse and azimuthal anisotropy. We are now beginning to assemble these observations into a consistent picture which will, hopefully, re-

late in some way to convection processes. Scattering and attenuation have long been of interest for two reasons. First, we need to understand more about the physical mechanisms of attenuation at a wide range of frequencies. Second, the seismic aspects of testban treaty verification require that we be able to correct for attenuation in order to make accurate estimates of seismic yield. While we continue to refine the large-scale variations of the attenuation parameter Q using normal modes, some interesting new results are providing information in the short-period band. It seems likely that there may be a significant frequency dependence of Q in the 0.8 to 1.5 hz range, corresponding to a simple relaxation band in pure shear. Regional variations in attenuation, and complications due to scattering, are known to occur, but many details of these phenomena are not well understood.

Seismic studies of the earth's crust have continued to expand during the last four years and now represent perhaps the most active area of seismology. Many of the techniques that have been perfected in the exploration industry are now being applied to the study of the earth's crust (particularly the deep crust) and upper mantle. At the same time, we are developing ways of generating synthetic seismograms for a wide variety of structures and are moving towards the application of inversion methods to determine structure.

U.S. activities in crustal seismology have been dominated by the continuing Consortium for Continental Reflection Profiling (COCORP) project, a portable 100 station array built by the U.S. Geological Survey (USCS), and an increased use of marine multichannel systems. COCORP continues to make detailed investigations of important structures in the United States and is contributing valuable new data to the regional geologist. Particularly interesting results were ob-tained in the Wind River Mountains of Wyoming, the Rio Grande Rift zone, and the Appalachian Mountains. The deployment of a large digital array in the Snake River Plain has clarified the transition from the Plain to the Basin and Range province. Other studies in California have provided valuable information on the Imperial Valley and the Mohave Desert regions. Marine studies using both reflection systems and ocean bottom seismometers have tended to focus on the continental margins. Here it has been possible in a number of areas to clarify the sedimentary col-

The crustal seismology studies overlap with many other investigations in the general area of seismotectonics, the study of processes in active regions. In this area, improved techniques in hypocenter location, long period budy wave modeling, and routine estimation of the seismic moment tensor have led to new insights into the faulting process. The characteristics of subducting slabs continue to be explored. Complexities in slab shape due to very shallow dipping subduction in some regions have been established. At deeper depths, more and more slabs are being demonstrated to contain clearly separated seismic zones, though the processes involved are still open to question. Interpretations of data collected during the Rivera Ocean Seismic Experiment (project ROSE) are now being published. These have provided detailed information on the relationship between seismicity and structure near a mid-ocean spreading ridge. Some events were clearly related to a topographic trough, while others were not obviously related to topography of the sea bottom. In another area, a number of investigations are beginning to unravel the complex tectonic processes at work in the Caribbean

In the field of earthquake prediction, progress in understanding short-term precursors has been slow. Efforts have been focused on improving our understanding of the nature of the earthquake process and its relationship

to host rock and fault gouge properties. Modeling shows distinct promise, and we are be-ginning to understand the ways in which complexities in prestress distribution and rock properties influence fault propagation and stopping. More success is being identified in the area of long-term predictors. Estimates of recurrence rates are constantly being improved, and the seismic gap concept has been successfully applied to the actual prediction of two earthquakes. The continued high level of research activity in earthquake prediction suggests that we are slowing moving towards success in this field.

Research in theoretical seismology has concentrated primarily on the synthesis of near. regional, and far field waveforms due to a variety of source models. In the near field, a number of techniques have been developed to take account of local structure. However, much remains to be done in including the complexity of the seismic source, which is the dominating factor at high frequencies. The construction of regional synthetics has been spurred by the test ban treaty verification program and is making substantial progress. Modifications to the classic Thomson-Haskell technique allow the calculation of P-SV and SH synthetics in a variety of structures. In he far field, the emphasis has been mainly on the inversion of network waveforms to derive the seismic moment tensor. Other theoretical studies have continued work on the dynamics of fault rupture, and wave propaga-

The field of strong motion seismology has grown rapidly during the last four years. The measurement, interpretation, and prediction of near field ground motion due to carthquakes has been impacted by a substantial growth in the number of instruments deed, in the amount of data available, and in the interest of agencies concerned with hazards reduction and potential damage to critical structures. Over 2700 strong motion accelerographs have now been deployed in the United States. While most of these are analog instruments, from which the data

need digitizing for processing, there are an increasing number of digital instruments. The 1979 Imperial Valley earthquake generated a particularly extensive data set that has been the basis for many investigations. Near field waveforms are affected by source characteristics, propagation path, and site response. While all are important, our ability to predict strong ground motion is apparently

most limited by our understanding of the seismic source The increasing use of digital instrumentation has not been limited to the strong mo-

tion area but is taking place throughout seismology. Most importantly, we are establishing a global network of digital seismic stations. consisting of the Seismic Research Observatories (SRO's) funded by DARPA and managed by the USGS, and the stations of the WWSSN network that have ben upgraded to digital capability by the USGS. The dynamic

range of these instruments has already prov-

en their immense superiority over the ak analog seismograms. At the same time, amount of data generated is large, and to amount or trace generalized is tage, and to are still in the process of establishing the or management techniques that will make the data easily available to the seismologish munity. In spite of this, the new digital de have made very significant contributor victually all areas of seismology, and we pect this to increase in the future.

**ERL Director** 

Resigns in Protest

George H. Ludwig resigned in protest last month from his post as director of the Na-

ional Oceanic and Atmospheric Administra-

ion (NOAA) Environmental Research Labo-

ratories (ERL). Ludwig, who will retire in February 1984 after 30 years of government

service, told Eas that he resigned "with the in-

within NOAA that he says are weakening the

agency's research program. Ludwig is now the assistant to the National Aeronautics and

Space Administration's (NASA) chief scien-

**EOS** 

The Weekly Newspaper of Geophysics

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lover. The continental crust of Europe

s divided into four tectonic realms, from

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and Alpine Europe. Within each realm a

ther to the age or style of deformation, to

the age and nature of the rocks involved,

or to the intensity of accompanying metamorphism and/or magmatism. Precambrim Europe (~3100–600 Ma) comprises (1)

the Baltic Shield, with exposed Precambri-

an crust, and the East European Platform

where Precambrian crystalline rocks occur

eneath younger sediments (except in the

Ukrainian Massif where the basement has

een uplifted and exposed) and (2) the

land Craton-Brabant Massif (stretching across the English Channel). Tectonically,

buried Precambrian basement of the Mid-

cambrian crustal rocks of north-

est Scotland and the Outer Hebrides be-

ing to the North American-Greenland

Shield. Caledonian Europe (~600-400 Ma) encompasses the British-Scandinavian Caledonides and the north German-Polish Caledonides. The supposed collision suture in the British Caledonides is shown with a data of the supposed collision suture in the British Caledonides is

hown with a dotted line. Most of the

deeply buried beneath younger sediments.
Hercynian Europe (~400–230 Ma) once
formed a wide mountain belt (the Hercyn-

aposed of a number of massifs of vary-

ing size, and intervening areas with Her-cynian basement. The supposed Hercyn-ian collision

in collision suture is shown as a dotted

ine. Alpine Europe (-230 Ma to present)

imprises the young mountainous regions orth and south of the Mediterranean,

med in relation to the collision between

te indented Eurasian and African plates.

A pre-Alpine Europe, incipient rifting altiated the formation of the Rhône-

Bresse-Rhine graben system around 50 Ma ago. The Mediterranean region is presently subjected to strong tectonic activity (Sec.

vity. (See news item p. 458.)

ides or Varisçan mountains), but is now

Aorth German-Polish Caledonides is

urther subdivision is shown, according ei

424-2488 or, in the D.C. area, 462-6903.

Officers of the Union

The NOAA reorganization process of the

tent of making a statement" about changes

While it is impossible to cover every into area of seismology, the review paper tha follow show clearly that seismology is as a tive, exciting field that is having an impage impact on many fields of geology and go

Contents: 1UGG Quadrennial Rep

Seismology in the United States 1979–198 M. A. Chinnery

Deep Earth Structure, V. F. Comier Seismicity, Focal Mechanisms, and Team D. W. Forsyth

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Strong-Motion Seismology, D. M. Boor Seismic Studies of Crustal Structure, R.A. Phinney and R. I. Odom

Developments in Digital Seismology, \$. \$.4.

# News

## **EGT Project**

The European Geotraverse (ΕGΓ) has been planued as a major geoscience project that will run for 5-7 years involving collaborative efforts of geophysicists, geologists, petrologists, geodesists, and other geoscientists from different European countries. A first draft proposal was elaborated in 1981 by a Workng Group of the European Science Research Councils (ESRC), a standing committee of the European Science Foundation (ESF): it was subsequently modified following the amendments requested by the ESRC and was finally approved by the General Assembly of the ESF on November 9, 1982.

The broad aim of the EGT is to secure an understanding of how the continental lithosphere formed and reacted to changing physical and geometric conditions through time. One of the best locations for such a study is Europe because it is made up of a number of tectonic provinces ranging in succession from the oldest Precambrian areas of Scandinavia to the currently active area of the Mediterranean. The concept of a geotraverse has been chosen in order to provide a continuous, integrated study of sufficient scale to cross this whole region like a swathe that will give new information about the dynamics and vertical and lateral variations of the lithosphere, both

within and between adjacent provinces. Geophysical and geological surveys carried out so far have revealed important features relevant to the objectives of the EGT. At the same time, however, they have disclosed a number of fundamental problems that can only be tackled within the framework of a wide-scope, multidisciplinary, large-scale proj-

Extending from the northern tip of Scandinavia southward to North Africa the EGT is located to encompass the pre-2500 Ma old Archaean nucleus in the northernmost part of the Baltic shield; the Proterozoic, Paleozo ic, and Cenozoic provinces of northern and central Europe that have been added on to this nucleus; and the active transition zone tween the Eurasian and African plates in the Mediterranean area.

The EGT has been chosen such that-proreeding from north to south—a 4000-kmlong section is obtained which, in three segments, covers the whole time span of the history of the continental lithosphere. From a tectonic-geologic point of view, Europe can be divided into three main units: (1) the Preot Fennoscandia (age ~3100 to -600 Ma) with its border regions, including the Caledonides (age ~600 to ~400 Ma); (2) the Hercynian (Variscan) realm of central and western Europe (age ~400 to 230 Ma); and (3) the Alpine-Mediterranean region (age 230 Ma to present).

A thorough understanding of the tectoric processes requires detailed knowledge of the structure and dynamics of the whole lithosphere, including not only the crust but also the underlying mantle, which is intimately

bound up with it. A large-scale gentraverse is required both to provide lateral continuity of information across the major structural elements of Europe and to achieve a deeper view of variations within the lithosphere. It is intended that the results of the investigations will be integrated to produce a north-south section through the crust and upper mantle of Eu-rope which will provide the basis for a recon-struction of the evolutionary development of the various provinces of Europe and their mutual interaction. This should provide a better insight into the structure and dynamics

of the lithosphere-asthenosphere system, which in turn will be of general scientific benefit. Although certain techniques are pro-posed for the full length of the EGT to provide continuity and depth of information, most of them will be applied selectively so that the combination of methods utilized will be those most appropriate to the particular problem under investigation. Vital to the concept of the EGT is that it should be carefully directed and contain within its broad-scale framework a number of linked experiments with specific geological objectives to derive

tion from explosive sources.

the detail that is essential. The goals of all these various experiments can only be accomplished by close international cooperation. Since the aims of the EGT require a continuity of information on a large scale, it is mandatory for these investigations to be carried out in the form of a "Joint Pro-

Two specific projects where the scientific jectives are essential to the aims of the EGT, but which cannot be realized along the EGT as such, have also been included in the EGT Joint Program. They are of fundamental importance to the understanding of the crust and mantle in Hercynian Europe.

### **EGT Joint Program**

 Simultaneous geomagnetic observations along the EGT.

2. Mapping of the resistosphere and conductosphere along the EGT.

3. Mapping of the lithosphere-astheno

sphere system by seismological techniques long the EGT (seismic surface waves, crustal transfer functions, and P delay studies).

 Deep seismic sounding of the litho-sphere (southern segment of the EGT). 5. Multidisciplinary (tectonic stratigraphic sedimentological, petrological, geochron cal, paleomagnetic, and anisotropy) studies as well as synoptic geophysical surveys in the Southern Alps, Po Valley, and Northern Ap-

Deep seismic sounding of the lithosphere (central segment of the EGT).

 Synoptic geological and geophysical studies of border regions between different tectonic units of Hercynian age (central seg-

8. Multidisciplinary study of the contact zone (Tornquist-Teisseyre Line) between Precambrian and Hercynian Europe (southern northern Germany). 9. South Scandinavian east-west traverse:

a multidisciplinary study across Sveconorwe-gian crustal units, the Oslo rift, the Protogine zone, the Smaland-Varmland granite belt, and into the Svecofennian provi

10. Multidisciplinary studies of the evolution of the Baltic Shield (seismic, magnetotel-luric, paleomagnetic, radiometric, and tectonic studies along the FENNOLORA Traverse and adjacent areas).

11. Large-scale anisotropy study of the up-per mantle in the Hercynlan domain of Ibe-

12. NARS: A wide-aperture seismological array surveying the upper mantle along the traverse Côteborg-Malaga (down to a depth of about 600 km).

Some of the experiments listed above making up the EGT Joint Program are already in an advanced stage of planning (such as ex-periments 4 and 8) and are scheduled to be carried out in 1985 and 1984, respectively. One of the studies (experiment 12) is already in progress. Steps toward the planning of the other projects have been undertaken by vari-

ous geological and geophysical institutions in a number of European countries.

Those experiments contributing to the baobjectives of the EGT on a regional and more detailed scale that can be realized as part of national or multinational programs are included as "Regional Studies." They are quite numerous and, therefore, for the sake of brevity are not listed here.

#### Organization and Coordination

A multidisciplinary international program of the size and duration outlined above will need an organization and coordination that secures the steady progress and realization of the EGT objectives. An EGT Scientific Coordinating Committee was formed to supervise the compilation and the inventory of the data and results relevant to the EGT. It will also identify and encourage those research proposals that meet the objectives of the EGT.

Three sectional groups, one for each of the northern, central, and southern segments of the EGT, will plan in detail and supervise the execution of the Joint Program and advise on those regional studies to which priority shall

The ESF Secretariat in Strasbourg will assist the Scientific Coordinating Committee in administrative matters and ensure the organization of sectional and regional working group meetings. It will also help in synchronizing the various activities, channel information, and organize an annual workshop of scientists who actively participate in the ECT.
Since the realization of the Joint Program,

running for a period of 5-7 years require funding beyond the scope of an "Addition Activity" of the European Science Foundation (ESF), it was proposed that contributions this program would have to be secured on national level by the appropriate funding agencies. The ESF in agreement with its pri mary role will coordinate the implemental of the national efforts.

A separate budget for the costs of "Coxto nation" has been established within the framework of an Additional Activity of the ESF, which is financed by contributions for the participating member organizations ready agreed upon at the last ESF General Assembly in November 1982.

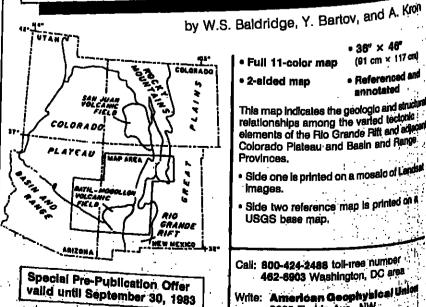
The Regional Studies will have to be food ed by the appropriate national agencies as cording to the specific scientific interess a needs of the different countries and the aable financial means.

The members of the EGT Scientific Con dinating Committee are St. Mueller (Zarid chairman; A. Berthelsen (Københava): P. Giese (Berlin): C. Morelli (Trieste): D. Bi dell (London); H. Zwart (Utrecht); A. Him (Paris); E. Banda, Scientific Secretary (Ins tute of Geophysics, ETH-Honggerberg.Cl-8093 Zürich, Switzerland).

Further information can be obtained through the Scientific Secretary or throu B. Munsch, Secretary of the EGT at the En ropean Science Foundation, 1, Quai Leta Marnésia, F-67000 Strasbourg, France

This news item was contributed by Stephen Mueller, Institut für Geophysik, ETH-Höngge

## Geologic Map of the Rio Grande Rift and Southeastern Colorado Plateau, New Mexico, and Arizona



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of ERL's long-standing management respon-sibilities elsewhere in the [Department of Commerce] and NOAA." He cited "the movement of most of our research support services (including manage-

past year has been unusually traumatic for ERL," Ludwig explained in a memo to his

ERL colleagues when he announced his de-

parture. "Specific actions have shifted many

ment of the Cyber 750 research computer and library)" to the NOAA/Commerce Department administrative support centers, our loss of most of the funds appropriated to solve our computing needs over the next decade, and the impending transfer of our research aircraft to the NESDIS [National Environmental Satellite Data and Information Service]." He told Eos that he feels the movement of these support services away from ERL means that these services will be less responsive to NOAA's research needs because the management control would be farther away from the research organization.

"This process has recently progressed to the point where decisions have been made before I was even given an opportunity to discuss them. This state of affairs clearly reflects a difference of opinion about the level of resource control and programmatic authority required by the ERL director," Lud-wig told his colleagues. "Although I have never argued for complete autonomy without responsible planning and accountability. I have consistently held the position that many elements of administrative decision making and the control of the tools of research should be at a level where the details of the research programs and of the process of research are clearly understood. In many instances this will no longer be the case, and I expect that

the research program will suffer."
Neither NOAA Administrator John Byrne
nor NOAA Deputy Administrator Anthony J. Calio has given an official reaction to Ludwig's resignation. However, Byrne told Eas that he is "disappointed that he [Ludwig] re-signed" and attributed the resignation to a sense of fatigue and frustration with the increasing bureaucracy placed on government employees, particularly with an administration that has altered the structure of government. Byrne also said that in the past few years NOAA has become closer to, and is doing more work in concert with, its parent Commerce Department. This could cut into the flexibility of middle level managers, Byrne said; he suspects this may have played

a role in Ludwig's resignation. Ludwig, a codiscoverer of the Van Allen radiation belts, joined ERL in 1980 as a senior scientist, coming from a management po-sition in the satellite service. It was a conscious move, he said, to go back to research In August 1981, he succeeded Wilmot Hess, now director of the National Center for Atmospheric Research, as ERL director.

When Ludwig became ERL director, he and NOAA Administrator Byrne discussed whether an ERL director was needed and whether the ERL director should be based in Boulder, Colo. "I felt we had an excellent basis of agreement," Ludwig said. One year later the entire issue arose again. The NOAA reorganization that was suggested in early 1982 included plans to coalesce five of the nine current ERL laboratories by combining them into a single regional laboratory. In this concept, the five current environmental research laboratories would have been downgraded to "program elements." Last August, though, NOAA Administrator John Byrne decided not to reorganize ERL. Since then. Ludwig says, a series of small but substantive changes have altered significantly the manent of research support services for

ERL's program. "Many of the changes which have actually occurred are, I believe, serving to weaken, rather than strengthen, NOAA's research activities," Ludwig told the ERL laboratory di-rectors and staff when he announced his resignation. Nevertheless, he told Eas, he still believes strongly in NOAA. He said he hopes his resignation will serve as a constructive step and that it will focus increased attention on the strengths of the NOAA research pro-

In the late 1950s while at the University of Iowa, Ludwig worked with James Van Allen and shared in the discovery and early delin-eation of the Van Allen radiation belts. After earning his Ph.D. at Iowa in 1960, he worked at the Goddard Space Flight Center in various capacities for a dozen years and then went to several management positions at the satellite service, Ludwig received the NOAA Program Administration and Management Award in 1977, the NASA Exceptional Service Medal in 1969, and the Academy of Achievement Golden Plate Award in 1962. Also that year he was pictured in Life magazine as one of 100 outstanding young men. He is a member of the Committee on Data Management and Computation of the National Academy of Sciences.

At NASA, Ludwig will work on space research data management. As part of the pro-lect, he will examine existing policies and general practices for the acquisition of data on space and will took closely at how such data are distributed, processed, and archived for research. The project aims to lay a foun-dation for future data management and pollformulation.

A search for a new ERL director is in the

initial stages -- BTR

## **Z**<sup>0</sup>: The Extra Force

Researchers at CERN (European Center for Nuclear Research) have reason to believe that they have finally observed the clusive superheavy Z<sup>0</sup> nuclear particle. The observation important because it represents the unifying link between the physics of weak-field nomena and electromagnetic forces. The particle was predicted by the Salam-Weinberg model, which is an attempt to pull together all physical forces into a single field theory. The as yet uncalibrated experiments at CERN project the new particle's mass at 95 ± 5 GeV, or about the equivalent to the combined masses of 95 protons. What remains in the search for such nuclear particles are "heavier Z°" particles (200 GeV), "top

quarks," and "Higgs particles," all of which are parts of the Salam-Weinberg model. The Z<sup>0</sup> particle is related to, and in some way analogous to, the photon (though much more massive). Photons and Z<sup>0</sup> particles are both involved in electromagnetic forces, but Zo carries an extra force, which is the weak field contribution that results in a violation of parity. The  $Z^0$  is considered the link between weak interactions and electromagnetic fields

because it benignly mediates both. The discovery of the Zo particle may mark the end of the experimental road for the pio neering aspects of particle physics. In a report about a recent discussion of the finding of the particle, R. Walgate says that further steps to test the grand unified theories will require comparatively high energies, on the order of 1019 GeV or higher. These energies are not feasible in any existing or planned fa cility (Nature, June 9, 1983).

The path of experimental research leading to discovery of the Z<sup>0</sup> was exciting, elegant. and perhaps was sufficient evidence of weak field existence in itself. F. Close described experiments to test for the "tell-tale signature of the presence of the extra (weak) force. The parity violation, or departure from mirror ulane symmetry, if detected, is a measure of weak force interaction. In parity-conserving interactions, the weak field effects are manifested in other ways. Indeed, experiments with left- and right-handed (poku ized). high-energy electrons have demonstrated imall violations of mirror symmetry. Likewise, experimental electron-position (collision-annihilation) processes have been controlled to detect weak fields by analyzing the resulting antimatter equivalents.

As was described by Close (Nature, May 26, 1983) "If the electron-position annihilation were controlled only by the electromagnetic

interaction, then processes that produce µ and u\* (muons and antimuons) would vield the  $\mu^*$  in the forward hemisphere marginally more often than in the backward. (Momentum is balanced by the  $\mu^-$  emerging in the other hemisphere.) If the weak interaction also plays a part, as in the Salam-Weinberg model, the µ\* should emerge more often in the backward hemisphere." Close goes on to describe that this is exactly what has been ob-

July 19, 1983 **EOS** 

served. The new CERN experiments involved proton-antiproton collisions in a device that is fed by the Super Proton Synchrotron (SPS). As the high-brilliance, high-energy beams collided, numerous particles were released, including weak-field charged particles (w+ and w<sup>-</sup>) and the neutral Z<sup>0</sup> particles. The decay of these particles produced tracks in the facility's gas-filled image chamber. As a Zº decays, an electron-position pair is emitted, the two producing diagnostic straight-line tracks in

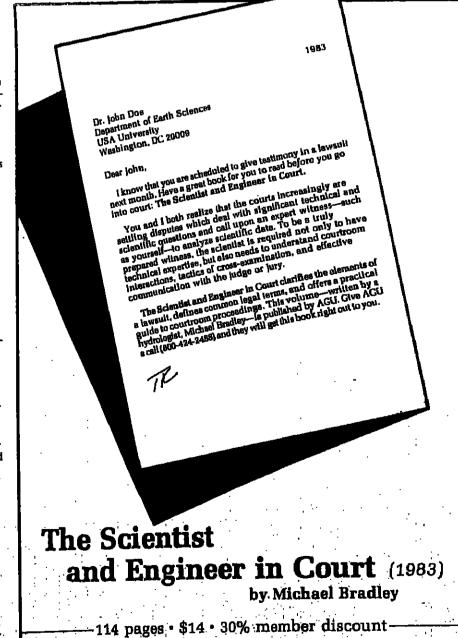
New directions in the study of electro-weak field theory, and its unity with electromagnetic field theory, will first involve improvements in the beam quality of the particle colliders. Higher energy experiments probably will not be obtainable in this decade. According to R. Walgate (Nature, June 9, 1983), "Another possibility is to search for Centauro events, seen a few times in cosmic rays, which indicate that a new kind of physics may set in at energies not much above present values."—PMB

#### New Pulsar Discovered

The discovery of a fast-spinning pulsar that is part of a binary system may provide a key to resolving the controversy over the nature of pulsars. Valentin Boriakoff of Cornell University, working with two Italian astronomers. Rosalino Buccheri and Franco Fauci, discovered the pulsar and its companion by using the 305 m radio telescope of the National Astronomy and Toposphere Center near Arecibo. Puerro Rico. The astronomers concluded that the newly discovered pulsar is part of a binary system because its pulsing period is not constant, a sure sign that something else

Spinning at 163 times per second, the pulsar is rotating slower than the pulsar discovered at Arecibo last November (642 times pe second), but the binary nature of the new dis covery may help answer the question whether

News (cont. on p. 460



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a pulsar's rate of spin is accelerated by the transfer of mass from a companion or whether a pulsar comes into existence already spinning. Most astronomers consider pulsars to be remnants of supernovas or exploding stars that collapsed into extremely small, dense objects and emit intense short bursts of radiation at regular intervals.

Designated P1953+29 for its coordinates in the sky between the constellations Vulpecula and Cygnus, the pulsar orbits its companion every 120 days. The pulsar is 11,500 light years from earth and has a diameter of about 9.5 km. Its mass has not been determined. Two unique features of P1953+29 are the emission of radiation for at least 42% of its rotational period (an unusually high rate for a pulsar with this particular spin rate) and its drastic changes in pulse shape at different receiver frequencies.

P1953+29 was discovered when the astronomers were searching the sky for fast-spinning radio pulsars in an area where a satellite had previously discovered some point sources for gamma rays. Because P1953+29 is located close to one of these point sources, the astronomers will try to find a physical association between the pulsar and the source by conducting simultaneous observations by using the Arecibo telescope together with other experiments. One of the first such projects is a simultaneous observation with the balloon experiment FIGARO, a French-Italian joint venture scheduled for release in Brazil in late

### Synchrotron Advances

Mineral physics studies, which gain precision as time decreases during a measurement will benefit greatly from the availability of beams existing from synchrotron facilities. Unusually intense radiation is emitted from a synchrotron in the broad spectral range from the infrared through the X ray region and beyond. For example, X rays, which are released from such a facility at intensities of 10° times those of conventional generators, can be used for studies of mineral structures, such as XFAS (X ray fine structure) and photoionization, which were unthought of only a decade ago.

One reason for this new capability is that accessories for synchrotrons called wigglers and undulators have evolved from the laboratory-curiosity stage to useful devices during the same period. These new devices step up the brilliance (flux per steradian for a unit source area of a narrow wavelength band) of a synchrotron-produced beam and can be adjusted so as to extend the spectral range of the radiation. The truth is that most of the old and even the new synchrotrons were designed or planned without the knowledge that wigglers and undulators would be successful, according to a recent report (Physics *Today,* June 1983).

Now a number of totally new synchrotron facilities are being proposed that will contain a large number of wiggler and undulator magnets, and, essentially, will not even make use of the normal radiation yielded by the synchrotron bending magnets. Wigglers and undulators are, of course, being adapted to existing facilities and to those under construc tion currently. All of this recent upgrading of synchrotron radiation beams will benefit

state-of-the-art mineral physics studies.
What is synchrotron radiation, and what

ISBN 0-87590-206-5 Climatic Changes

M.I. Budyko English Trans., R. Zolina English Trans., editor, L. Levin (1977)

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are wigglers and undulators? Electrons and sitrons are the charged particles that are accelerated around a circular path in a synchrotron. The curved motion is the steadystate acceleration (change in direction) and this causes the particles to lose energy. Synchrotrons were originally designed to study or otherwise employ the high-energy,

charged particle beam, not the white radiation that is emitted as the energy loss due to the curved motion in a magnetic field. This white radiation had been thought to be of potential future use in physical measurements. It is this radiation that is being exploited for mineral physics and other condensed matter

The standard bending magnets in a syn-chrotron yield intense, broad, fan-shaped beams of radiation (for electrons of 1 GeV the cone angle of emitted radiation is about 1 mrad). For X ray diffraction studies of minerals, however, the wavelengths are not sufficiently short and simultaneously intense after passing through collimators and monochrometers to be of significant improvement over

conventional X ray generators.

Wigglers and undulators are periodic magnets that can be inserted in the sections of an electron storage ring that are free of other magnetic fields. These devices cause electrons passing through their fields to curve around and accelerate over relatively short distances and thus radiate the energy they lose in the process. The resulting radiation is a very narrow beam of greatly enhanced brilliance and extended wavelength.

The five synchrotron facilities in the United States are SURF (at the National Bureau of Standards in Maryland), CHESS (at Cornell University), SPEAR (at Stanford University), Tantalus and Aladdin (at the University of Wisconsin), and NSLS I and II (at Brookhaven National Laboratory). They are already in service in mineral physics studies, a few examples of which are instantaneous, single-crystal X ray structure determinations; high-pressure, diamond cell in situ, X ray diffraction measurements; bonding studies by energy-dispersive XFAS; and electronic structure measurements by photo-emission, in which the white synchrotron radiation can be tuned to observe the electron levels --- PMB

## **AIPG Membership**

Members of AGU now are qualified to apply for membership in the American Institute of Protessional Geologists (AIPG). The constitution and bylaws of the geologists' association require that applicants for membership hold prior membership in one of the societies affiliated with the American Geological Institute or in other scientific societies specifically approved by AIPG; AGU has been approved by the executive committee.

For additional information, contact AIPG national headquarters at 7828 Vance Drive, Suite 103, Arvada, CO 80003 (telephone:

## Is Space for Ordinary People?

A blue ribbon Advisory Council to the National Aeronautics and Space Administration (NASA) recently reported the results of its 1year study on whether to send private citizens on space shuttle missions. The answer from this panel, which was made up of an astronaut, a physician, several major space indus-try executives, and the author James A. Michener, was yes. If this result is acted upon, private citizens may fly on a shuttle mission in his decade.

The NASA Advisory Council claimed at the outset that the concept is not to be misconstrued as a self-serving public relations program. The main objective, it would appear, is for laymen to provide real function in space missions; they could add a valuable dimension to the missions, if only by communicating first-hand space experiences to the general public, But, in addition to the widespread public interest in space, ordinary citizens are needed now and in the future: Inspace technological manufacturing plants appear to be a good bet in a decade or so, and civilians can contribute to readiness programs as they work with highly specialized astronaut

Results of feasibility analysis of the private citizen in space are summarized as follows: (I) Individuals can be flown by NASA without undue risk to either crew safety or

accomplishment of the specific mission.
(2) Seats will be available, but there will be competing demands for them. Planning for a minimum program at this time is the best

way to ensure seats for this opportunity. (3) The flight experience is not particular stressful if the person is trained in what to expect. If trained, one could adapt easily to the habitability requirements and the mission

(4) The medical requirements will not be as rigorous as those for astronauts. They will focus on preventing medical/psychological situations developing in space that are hazardous to any or all who are involved.

A large part of NASA's objectives with the space shuttle program consists of addressing commercial and national security needs by gaining worthy experience in space. Accord

TO THE RESIDENCE OF THE PARTY O

ing to the Report of the NASA Advisory

"The Space Act authorizes NASA to pro vide the widest practicable and appropriate dissemination of information concerning NASA's activities and the results thereof (203(a)(3)) and to foster the preservation of the role of the United States as a leader in aeronautical and space sciences and technolo gy' (102(c)(5)). NASA has been conducting effective information and education programs under this charter for some time. Persons who would produce more comprehensive mission documentation and educational material would significantly implement NASA's charter and augment its current ac-

Private citizens they may be, but the choice of the first several individuals will be the result of rigorous procedures, not only because of physical and medical considerations, but because their important contributions to the tasks of the space shuttle are in rather critical need. NASA needs capable help in space right now by people of various disciplines, people who can go on a space shuttle flight with as little as 100 hours of training in a 2month period, not 5 or more years as is the case with shuttle astronauts.

Eventually, the program will be expanded. The current plans are to have an observer-inspace program of narrow scope but of great potential benefit to space science and indus-

## TV Series on Geophysics

A seven-part public television series on earth sciences, dubbed "Terra Nova," is expected to begin filming this fall. The series, slated for prime time, is also designed as an introductory course in geophysics for college students who are not science majors. Completion of filming is expected in 1985; no air date has been scheduled.

Public television station WQED, Pittsburgh, in association with the National Academy of Sciences (NAS), is producing "Terra Nova." WQED and NAS collaborated on the production of the Planet Earth series, which originally aired some 25 years ago. The Annenberg/ Corporation for Public Broadcasting (CPB) Project has provided a \$3 million gram for "Terra Nova." Two years ago AGÜ gave \$10,000 for NAS to develop basic scientific plans for the geophysics series.

Among the topics to be explored in the series are solar system cosmology, comparative planetology, solid earth geophysics, plate tectonics, mineral resources, hydrology, oceanography, climatology, meteorology, the sun, solar-terrestrial interactions, energy tesources, human impact on the earth's environment, and the geologic environment.

To assist WQED in the production of the series, NAS established a blue-ribbon Geophysics Film Committee. Hugh Odishaw, dean of the College of Earth Sciences at the University of Arizona, is the committee's chairman. Other committee members are G Arthur Barber, Charles L. Drake (AGU President-elect), Herbert Friedman, Laurence M. Gould, Thomas F. Malone, Roger Reveile, Alan H. Shapley, Eugene M. Shoemaker, Walter S. Sulivan, Verner E. Suomi, James A. Van Allen (AGU President), Pembroke J. Hart (committee secretary), John P. Schaefer, and J. Tuzo Wilson (former AGU President). NAS will provide scientific guidance throughout the series' production to ensure the scientific integrity of the films, according to Pem-



For college instructional purposes, Te Nova" will include an innovative approach the development of study guide material, series' planners say. Computer text proces ing and laser printing will provide college professors the opportunity to virtually on their own guide materials for the seits, which will be divisible into 14 half-hours ments for classicion use or for rebroadas on a syndicated basis by public televisions tions after the original prime-time along is hour-long segments.

"Geophysics has progressed enormous; the past 25 years since Planet Earth was no duced," said Thomas Skinner, executive president of WQED and project director for the new series. "There was no deep ocean ploration then, no space program. This be the first time anybody has put together this information on geophysics into usale form. It is a marvelous subject matter to de

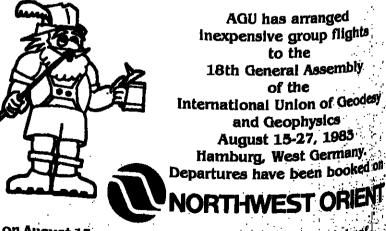
with and a chance to produce a landmark The Annenberg/CPB Project, funded in 1981 by a \$150-million grant from the Ac nemberg School of Communications, is ad ministered by CPB. Others who have com uted to the financial support of "Tema No are the American Meteorological Society de Society of Exploration Geophysicist, the b-thur Day Fund, and the Atlantic Richfield Foundation.—BTR

## New AGU **Style Guide**

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### Climate History and the Modern World

H. H. Lamb, Methuen, New York, xix + 387 pp., 1982, \$35 (hardbound), \$16.95 (paper). Reviewed by William E. Riebsame

H. H. Lamb's latest book on the earth's changing climate is a carefully crafted work covering four areas: the physical basis of climate and climate change, the methods of climate reconstruction, the history of climate since the height of the last glaciation, and the impact of climate on human affairs. The book will be of particular interest to three roups. Atmospheric scientists interested in the long history of climate behavior (but perhaps overwhelmed by Lamb's all-encompass ing work on the topic, Climate: Past, Present and Future, vol. II, Methuen, New York), will find Climate History and the Modern World to be a good titration of the fuller work. Scientists in other fields, including social scientists grappling with issues of climate-society inter-action, will find the book a good entree into he field. Finally, Lamb himself suggests that he book will be useful to resource managers and other decision makers trying to avoid negative climate impacts. With this last audince in mind, no doubt, Lamb has chosen a syle that eschews extensive footnoting and elerences (though sufficient citations are induded to lead to further information). This works quite well and seems reasonable in view of his carefully documented previous

Lamb's discussion of basic climatology paintains the connections between individual weather (e.g., extratropical cyclones) and climate elements and the broader issue of climate change. This integration fails, however, in sections on tornadoes and convection. His scussion on causes of climate is excellent slibough parts of it are curiously repeated ater in the book) for its demonstration of how climate at a point might change owing to ustabilities inherent in the climate system without recourse to solar input, volcanic activity, and chemical changes in the atmosphere. When he does discuss these external forces, Lamb clearly delineates their climate role, uncertainty, and potential impacts. Lamb's review of reconstruction techniques is an excellent, parsimonious discussion emphasizing historical sources. It includes a valuable table utlining techniques and their application. lamb's summary of climate history, comprising slightly over a third of the book, is a compendium of sources, regions, and events that only be could produce. This section can stand alone as a guide for the climate historian, though it may provide too much detail for more casual readers who will probably find more interest in the section on climate im-

The climate history ends with 1950, and the subsequent record is incorporated into a discussion of the historical and contemporary ocioeconomic role of climate fluctuati This section is a mix of fact and opinion (facts like harvest failures and opin their historical moment). Lamb, like all climate historians, operates in a field of pitfalls related to the sufficiency of proof to implicate climate in past events. Some of his colleagues in the Climate Research Unit at the University of East Anglia, U.K., have recently written on how difficult it is to prove causality in past climate impact studies (M. J. Ingram, G. Farmer, and T. M. L. Wigley, Past climates and their impact on man, A review, in Climate and History, edited by T. M. L. Wigley et al., Cambridge University Press, New York). Nevertheless, Lamb's suggested impacts are reasonable, and his insight is a valuable guide to where we might look to refute or support the historical importance of climate change.

Having demonstrated the variability of climate and argued for its important role in human endeavor, Lamb ends the book with suggestions on how we might better cope with climate vagaries. He argues for climate fore-casts based on empirical probabilities; indeed, Lamb clearly feels that forecasts based on theoretical atmospheric models may be misleading and bemoans the "disproportionate" research efforts put into computer modeling rather than into a fuller reconstruction of past climate behavior. Unfortunately, his discussion of climate forecasting is not as well organized as the rest of the book, and readers will be confused by the different time scales and approaches touched upon. Additionally, he pays little attention to whether even a correct forecast will be believed and acted upon. If climate forecasts are to help us with the "climate problem," we must know more about their applicability to resource

Lamb begins and ends the book by claim-ing that global society is becoming increasingly vulnerable to disruption by climate, a view he supports with Malthusian reasoning. Whether a climate anomaly eventually pushes some segment of global population into a Matthusian disaster or whether we simply continue to experience the hardships reasonably attributable to climate in conjunction i political and social causes, there is no doubt that we must strive to understand climate better. But we should not fall into the trap of doing nothing until we know every-

thing. Lamb's book suggests that we already know a great deal about climate, and it makes this body of knowledge more accessible to a wide range of workers. No doubt, many more ives and much property could be saved by further drawing from this knowledge and our increasing understanding of climate-society interaction

William E. Riebsame is with the Department of Geography, University of Wyoming, Laramie, WY 82071.

#### Numerical Dating in Stratigraphy, 1 and 2

G. S. Odin (Ed.), Wiley-Interscience, New

Reviewed by Marvin A. Lanphere

Geology is a historical science, and geologists always have been fascinated with deciphering complex geologic histories by unray eling the relations of rock units where ages were established by fossils or, more recently, by isotopic dating methods. The most direct way to date stratified rocks is by measuring the ages of authigenic minerals in sedimenta ry rocks. This approach, however, is fraught with such problems as the presence of detrital minerals, the determination of whether authigenic minerals formed at the same time as accumulation of the sedimentary rocks, and whether suitable minerals for age measurements are present. This new book shows that although there has been significant progress, the problems of directly dating sedimentary rocks by isotopic methods persist.

The book is in two volumes. The larger part of the first volume is devoted to method ology. Subjects that are covered include methods of correlation; isotopic dating methods; and utilization of minerals from sedimentary, volcanic, and plutonic rocks for physical age measurements. The rest of the first volume consists of papers dealing with calibration of the geologic time scale. The second volume contains 251 abstracts based on stratigraphic and isotopic data for critical points on the time scale.

Of the 34 papers in the first volume, 19 are contributions to Project 133 of the International Geological Correlation Program (IGCP) tuled "Geochronology of Sediments," Most of the participants in this IGCP project were from European countries, and a primary objective was to establish a radiometric geochronology for the Mesozoic and Tertiary strato-

types in various parts of Europe. Unfortunately, interbedded volcanic rocks are rare, and the principal materials available for physical dating are glauconies, a general term used herein for authigenic green pellets in some sedimentary rocks. (Glauconite, a potassium-rich mica, is a relatively rare, highlyevolved glaucony.) The term "glaucony" has not yet made its way into geological dictionaries. Many of the studies deal with dating glauconies by using the potassium-argor nethod. Great progress has been made in understanding the mineralogy and evolution of glauconies, but the fact remains that they are less reliable for isotopic dating than are

certain minerals in igneous rocks.

I found the part of the first volume on calibration of the geologic time scale to be uneven and disappointing. There were papers on the lower Paleozoic, upper Paleozoic, and Carboniferous; four on the Triassic; and one each on the Jurassic and Cretaceous, the lower Cretaceous-upper Cretaceous boundary, the Paleogene, and glaucony ages of the southeastern United States.

The second volume is by far the most valuable part of the book. The editor is to be commended for his success in persuading a diverse group of people to compile strati-graphic and analytical data and to present a critical discussion of many of the important time-scale points within a uniform and concise format. This second volume will be a new for reference source for many years to come. Most of the abstracts deal with glauconies. Several time-scale points included in earlier compilations (for example, the 1964 Phanerozoic time scale of the Geological Society of London) have been omitted, apparently be cause the data are on plutonic rocks where stratigraphic age is not precisely fixed. Failare to arrange the abstracts in the second volume in any systematic order is confusing and detracts from their usefulness.

The volumes are well produced, and typo graphic errors are rate. All references are at the end of the second volume, an arrangement I found a bit inconvenient. In several contributions, the English usage is a bit awkward, apparently because these are by authors whose primary language is not English The book could have benefited from a more merciless editing by the publisher. Given its cost, this book probably will not be purchased by many other than libraries and geochronologists. If the second volume could be issued separately. I believe it might enjoy wider cir-

Marvin A. Lanphere is with the U.S. Geological Survey, Menlo Park, CA 94025

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OSITIONS WANTED

Geologisi. Ph.D., S3, German. Experience in consulting, teaching and research (rock stress determinations, structural geology). Foreign experience in Europe and Middle East. Seeks position at university or industry, North America or overseas. Will be used to the process of the consultation of the process of the process

POSITIONS AVAILABLE

Selamologist, Geophysicist/Carnogle Institution of Washington.
A post doctoral position has just become available at the Department of Terrestrial biggetism for a seismologist/geophysicist with the letters of reference to be sent to Geophysics Hellowship Committee, Department of Terrestrial Magnetism, Carnogle Institution of Washington, 20015.

Selsmologist. The Institute for Petroleum Research and Geophysics in Holon, Israel, is seeking a seismologist to work on problems of earthquake risk sustament. Employment is for a period of one year with possible extension. Experience in statistical exchange of earthquake risk is preferable but not mandatory. The Institute is a government owned company located in a suburb of Tel Aviv. It is responsible for most of the geophysical work in Israel and it has an active selsmological program including countrywide and local telemetered seismic networks. Jovanne and a car. For details contact Dr. A. Sapira, Head, Seismological division, The Institute of Petroleum Research and Geophysics, P.O. Box 1717, Holon 68117, Israel, telephone 03–805112.

University of Colorado, Boulder, Geochemist Position. Geochemist with active research program, stable isotopes, radioactive isotopes, and/or trace elements is being sought for a joint appointment in the Department of Geological Sciences and the Cooperative Institute for Research in Environmental Sciences (GIRES) of the University of Colorado.

The one-half time position within the Department of Geological Sciences is tenure track at the assistant or associate professor level with a starting salary of \$12,000—\$15,000 for the academic year.

Teaching load will be half that of full-time faculty. The position within CIRES will be as a Fellow with appropriate office and laboratory space. One-half academic years at the departmental rate, after which incumbent must generate his/her CIRES salary from external sources. Incumbent may augment salary further by generating three months of summer salary from contracts and grants, and consulting.

ing.
Applicants with experience, publications, and/or movable existing research equipment preferred. Preferred starting date would be January 1, 1984. Closing date for applications is October 1, 1989. Applications should include statement of research and teaching interests, experience, a full vitae, and four letters of reference.
Apply to: Professor Charles Stein, Chairman, Geochemist Search Committee, Department of Geological Sciences, Campus Box 250, University of Colorado, Boulder, CO 80309.
The University of Colorado is an equal opportunity/affirmative action, Section 504 employer.

Florida International University/Faculty Positions in Geology. The Earth Sciences program at Florida International University is expanding and plans to increase the number of its faculty positions in the next few years. In order to complement existing instructional and research strengths, the university invites applications for tenure track positions at the assistant professor level in the following areas of specialization.

Geology
Successful applicants must have demonstrated an ability to conduct high-quality teaching and the potential to establish a productive research program in

their area of specialty.

Subject to final approval of funding, appointments will begin in August 1983 (deadline for application July 30, 1983) and/or January 1984 (deadline for application November 15, 1983).

Send a resume, brief description of teaching and treatarch interests, transcripts and three letters of recommendation to:

recommendation to:
Dr. L. Keller
Department of Physical Sciences
Florida International University
Tamiami Trail, Mismi, Florida 33 199
Florida International University is a member of the Florida State University system and an affirmative action/equal opportunity employer.

Research Scientist/Atmospheric Science/MIT.

The Center for Meteorology and Physical Oceanography at MIT seeks applications from new or recent Ph.D.'s in atmospheric sciences for a research position involving the interpretation of NIMBUS-7 and SAGE satellife data on stratospheric trace gases and acrosols. The general aim is to improve our understanding of atratospheric chemistry and of the three-dimensional and residual-mean two-dimensional transport of tracers in the upper atmosphere. Appointment duration is one to three years. Familiarity with computing techniques used in multi-dimensional atmospheric circulation models is necessary. Please send curriculum vitae and names of three references to: Professor Ronald G. Prinn, c/o Vera Ballard, MIT, E19–238, Cambridge, MA 02139.

MIT is an equal opportunity/affirmative action

Postdoctoral Position/Washington University.

Electrochemist to study trace ion behavior in high temperature (> 1000°C) silicate melts of geochemical interest and direct silicate electrolysis as a smelting technique. Experience in high temperature electrochemistry essential, in silicate electrochemistry yearning preferred. Background in inorganic chemistry desirable. Position available November 1983, salary \$18,000 per year. Send resume, transcript, and names of three references to Larry Haskin, Department of Earth and Planetary Sciences, Washing-ion University, Sr. Louis, MO 65130. An affirmative action/equal opportunity employ-

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Lecturer in Geophysics/The University of New England, Australia. Applicants should have a Ph.D.
degree or coutvalent qualifications in Geophysics, be
able and willing to teach undergraduate courses and
supervise higher degree students in Geophysics, and
be capable of undertaking appropriate high quality
research. The Department specializes in magnetic
and gravity methods particularly in the context of
mineral exploration. However, applicants with experience in any major field of applied or theoretical
geophysics will be considered for this position. The
appointment is available from 1st February, 1984,
and the appointee will be expected to take up dutles
at that time.

The appointment will be to the permanent staff
but the University reserves the right to make the appropriate. Salary \$A22,450-\$A29,467. Other conditions include superannuation, assistance with travel
and removal expenses and with buying or building
a house in Armidale.

Applications, including the names and addresses
of three referees, should be sent to the Staff Officer,
University of New England, Armidale N.S.W. 2581,
Australia by 26 August 1988. Applicants should forward a copy of this advertisement to their referees
and sak them to send their reports direct to the
Staff Officer, Mr. B.G. Turner marking their covelopes "Private and Confidential" and quoting position number 450. Informal enquirles to Associate
Professor B. Runnegar, Department of Geology &
Geophysics: (067) 75 2861.

Research Scientist II. The Solar-Terrestrial Theory Group at the University of New Hampshire seeks applications for a research scientist II to undertake a variety of theoretical problems on plasma and MHD processes in the solar atmosphere and the solar wind, and related energetic particle phenomena.

the solar wind, and related energetic particle phenomena.

Minimum qualifications: Applicant must possess a Ph.D. or equivalent professional degree, with research leading to doctorate, with training in theoretical space plasma physics or a related field, (e.g., theoretical plasma fusion research), or masters degree and at least three years of research experience which is closely related to project work. Salary range \$20,110 to \$31,260; normally attring salary not to exceed \$22,510. Resume and three letters of reference should be sent before August 15, 1983, to: Dr. J. V. Hollweg, Department of Physics, University of New Hampshire, Durham, NH 03824.

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University of Nevada/Selamological Laboratory.

An immediate postdoctoral fellowahip is available for research on selamic and volcanic hazards in the southern Sierra Nevada of California and Nevada. Emphasis will be on studies of earthquake distribution and mechanisms in the area of interest conference. don and mechanisms in the area of interest, config-uration of the Long Valley magma chamber, and development of advanced software tools for analysis of data from a network of analog and digital seismic stations. A Ph.D. degree, corned for work in sels-mology, is required, as is experience in network seismology. The appointment will be for one year, renewable for one year. Sond renume to Alan Ryall, Seismological Laboratory, University of Nevada, Reno, NV 89557-0018.

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Visiting Position in Structural Geology/Tectonicas University of Michigan. The Department of Geological Sciences invites applications for a one- or two-year visiting position at faculty rank, to begin September 1, 1983, or at the latest, January 1, 1984. A PhD is required and research interests in Structural Geology or Tectonics should match those of current faculty (Professors T. Lay, H.N. Pollack, L.). Ruff, R. Van der Voo, and D.V. Wiltschko). Teaching responsibilities will be, on average, one course per semester; a structural geology course for undergraduate concentrators it among these and is offered in the winter semester. Minimum salary of \$22,000/scademic, year or higher depending on experience. Interested persons should send a resumen, names of three persons from whom the department may request letters of recommendation, and a brief statement of research interests to Rob Van der Voo, Chairman, Department of Geological Sciences, 1006 GC. Little Bullding, Ann Arbor, MI 48109. The search will close August 10, but later applications will be considered.

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Iowa State University of Science and Technology, Department of Earth Sciences/Research Associate: Electron Microprobe. The Department of Earth Sciences invites applications for a Research Associate position as an electron microprobe specialist. The appointment will be a fully funded, permanent, twelve-month position. Salary will be commensurate with qualifications.

twelve-month position. Salary will be commensurate with qualifications.

Primary duties are the operation and maintenance of a fully automated microprobe with WDS and EDS capabilities and the supervision of associated laboratory facilities. Additional duties include the instruction of research personnel in instrument operation. Ample opportunities exist for conducting collaborative and independent research involving the anicroanalysis of geological materials.

Applicants should have a M.S. degree in a science or engineering field, or equivalent experience, and experience with electron beam instrumentation. Persons with a working knowledge of WDS and EDS spectrometers and the accompanying computer operations and experience analyzing geological samples will be preferred applicants.

Applications deadline is july 31, 1983. Later applications will be accepted if the position is not filled. Applications should include a complete resume, a statement of background and interests, copies of publications and names of at least three references. Applications should be sent to:

Applications agent names of at least three references.
Applications should be sent to:
Bert F. Nordile
Department of Earth Sciences
Iowa State University
253 Science 1
Ames, Iowa 50011
Iowa State University is an equal opportunity/affirmative action employer.

Atmospheric Scientist/Arecibo Observatory. The National Astronomy and Jonosphere Center has a staff position available in the atmospheric sciences groups at the Arecibo Observatory in Puerto Rico. It is expected that this will be a long term appointment with the level depending on experience and qualifications. Applicants should have a doctoral degree and a demonstrated ability to pursue an independent research program in the atmospheric sciences. Interest and experience in the remote sensing via radar of the iomosphere or lower atmosphere or in the field of lonospheric Modification is highly desirable.

The successful applicant will have full access to the facilities of NATC. For atmospheric research these include the high powered 430 MHz incoherent scatter radar, a bistatic 2580 MHz radar for stratospheric studies, sirglow instrumentation and a H.F. Iomospheric Modification Leility. A 50 MHz radar intended for MST studies will be available shortly. Scientific staff members at Arecibo have most of their time force to pursue their own research. They are also expected to provide assistance to visiting scientists and support for the Observatory's operation.

to visiting scientists and support to the scientists operation.

Applications including a resume and names for three references should be sent to:

Dr. Tor Hagfors, Director

National Astronomy and lonosphere Center

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Research Professor in Marine Geoscience/University of Rhode Island. The Graduate School of Oceanography invites applications for a research professorship in Marine Geoscience whose salary and rank are negotiable. Preference will be given to candidates who have clearly demonstrated abilities and interest in, but not necessarily limited to paleomagnetism. The position is funded by contracts and grants, however the research professor holds full faculty rights in addition to other benefits. The paleomagnetic facility at GSO is fully equipped, fully operational and oriented towards rapid measurement of large numbers of soft sedimentary samples. Applications are now open for the position which will become available about january 1, 1984. Send letters of application, resume, and names and addresses of three professional references to: Roger L. Larson, Graduate School of Oceanography, University of Rhode Island, Narrugansett, Rhode Island 02882.

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RESEARCH

The Department of Mineral Sciences at The American Museum of Natural History is seeking applicants for a curatorial research position in Economic Geology. Major responsibility is to carry out a vigorous research program involving field and laboratory studies on the origin and development of one deposits anywhere in the world. Work are encouraged. Involvement with graduate students, if desired, is also possigrams (symposium or exhibition). The position offers the freedom and support to the or academic responsibilities.

The Department has excellent laboratory facilities including an automated electron microprobe, X-ray facilities, sample preparation laboratory, photographic and graphic aupport, and computers. A PhD in Economic Geology is required and the position is open to persons of any rank, with salary negotiable.

Candidates should submit a resume (including a statement of research interest), salary requirements, and the names of three references by October 15, 1983 to:

Or. Martin Prinz, Search Committee

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## **Visiting Research Scientist Radio Emission Processes**

Applications are invited for a visiting research scientist position in the Department of Physics and Astronomy, The University of Iowa. Iowa City, Iowa.

This position is intended to support a multidisciplinary study of planetary, solar and astrophysical radio emission processes funded by the NASA innovative research program. Applicants must have a Ph.D. with a good theoretical background in basic plasma physics and experience in either experimental or theoretical studies of planetary, solar or astrophysical radio emissions. Our intention is to favor established scientists with research experience in this area, although junior scientists with an appropriate background will also be considered. The salary will be commensurate with the experience level. The appointment can be for any period up to one year, with a possibility for extension to a second year, depending on funding constraints. Send curriculum vitae and a list of three references to:

> D. A. Gurnett Department of Physics and Astronomy The University of Iowa Iowa City, Iowa 52242 Telephone 319/353-3527.

The University of Iowa is an affirmative action/equal opportunity

Research Scientisi/Space Plasma Physics, University of Iows. A research position is available in the Department of Physics and Astronomy. The University of Iows, for theoretical and interpretative studies of waves in space plasmas. Specific emphasis is on theoretical investigations of wave-particle interactions in planetary magnetospheres and in the solar wind. These investigations are to support the interpretation of data being obtained from spaceraft projects such as Dynamics Explorer, International Sun Earth Explorer and Voyager. The applicant must have a Ph.D. with good qualifications in plusma physics theory and shoul have some experience in the interpretation of space plasma physics data. Send a resume and the names of three references familiar with the applicant's work to: D.A. Gurnett, Department of Physics and Astronomy. The University of Iowa, Iowa City, Iowa 52242, telephone 319-353-3527.

The University of Iowa is an affit mative action?

Research Assistant in Ice Core Analysia/Ohio State University. Applications are invited for a position at the Institute of Polar Studies, The Ohio State University, beginning October 1, 1985, Primary duties of the position will include operation and maintenance of the Coulier counters in the class 100 clean room, and processing ice and firm samples. Minimum qualifications are BS degree in physical science or engineering and suitable Liboratory experience (or equivalent experience). Please send applications, deadline 1 September 1983, to Director, Institute of Polar Studies, Ohio State University, Columbus, Ohio 48210.

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Geophysician/University of Saskatchewan. Subject to final budgetary approval, the Department of Geological Sciences will have a new tenurable position in geophysics available July 1, 1984. Applicants should hold, or be about to receive, the Ph.D. or equivalent degree. They will be expected to teach undergraduate and graduate courses in geophysics and to build and maintain a vigorous research program. Excellent research opportunities exist in crustal and exploration seismology and in all fields of mining geophysics. The department, to occupy a new building in 1985, already has well-equipped geophysical and data-processing facilities. Applicants should send a letter outlining their teaching and research goals, accompanied by a full curriculum vitae including the name of at least three referees, to Dr. W. G. E. Caldwell, Head, Department of Geological Sciences, University of Saskatchewan, Saskatoon, Canada S7N 0VO.

Research Scientist/Stochastic Models of Atmospheric Blocking. A Postdoctoral position for the study of stochastic models of atmospheric blocking is available immediately. Send resume and arrange for three letters of recommendation to be sent to: Professor Katja Lindenberg, Department of Chemistry, B-014, University of California at San Diego, The University of California at San Diego, The University of California is an equal opportu-ity/affirmative action employee

GNOC Chair in Mapping, Charting and Geodesy (Hydrography)/Department of Oceanography, Naval Postgraduate School, Monterey, California.

Under the sponsorship of the Commander, Naval Oceanography Command (CNOC) a Chair in Mapping, Charting, and Georlesy (MC&G), with emphasis on Hydrography, has been established in the Department of Oceanography, Naval Postgraduate School (NPS). The objective of the Chair is to promote MC&G studies and research by students, and faculty, and to encourage acquaintance of the Chair with Navy needs in the MC&G field.

The incumbent's principal responsibilities will be to conduct research and to supervise student thesis research of a type that will interface the Hydrographic Sciences Program of NPS with the MC&G needs of the Navy. A favored theme is research applicable to operational hydrographic survey problems.

Academic excellence and the ability to being the access to the conduct research of the policy of the program of NPS with the MC&G needs of the Navy. A favored theme is research applicable to operational hydrographic survey problems.

The University of Iows is an affirmative action/ equal opportunity employer.

Anticipated Opening/Research Associate. The coastal Ecology Laboratory Center for Wedard Resources, LSU, has an anticipated opening beginning October 1983. Rank and salary dependent upon qualifications and experience, Ph.D. in coastal hydrodynamics and nutrient transport is preferable. Responsibilities will include development and application of computer models and water quantity and quality aspects, supervising computer programming and preparing technical reports. Background in hydrology, ecology and estuary will be helpful. Experience in statistical, mathematical and muncrical unalysis is desirable. Send transcript, resume and three-letters of recommendation to: Dr. Flora C. Wang, Department of Marine Sciences, Louisiana State University, Baton Rouge, LA 70803 before August 19, 1083.

LSU is an equal opportunity employer.

RESEARCH POSITIONS AVAILABLE

The Lunar and Planetary Institute is a center for Planetary and Earth School research associated with NASA m grams. The Institute presently has 2101 positions available at the posidocinal and staff scientist levels. Appointment are initially for one year with the possit ity of renewal for additional years.

Areas of current research interestable Institute include: geophysical analysi of global data sets; planetary geological including the analysis of surface image and theoretical and experimental studies of impact cratering terrelia remote sensing with special references volcanic phenomena; planetary tector ics, especially of Mars, Venus and the Earth; and the early crustal genesis of terrestrial planets.

Applications from specialists in all area of planetary and earth science are invited and will be particularly welcome from researchers whose work augments or complements existing programs.

LPI facilities include a computer cer equipped with a VAX 11/780, an image processing facility equipped with a Godf DeAnza IP 8500, a geophysical dea facility with interactive graphics capable ity, extensive library holdings in the geosciences, and a major collection of space photography.

The LPI, funded by NASA through the Universities Space Research Association, is located adjacent to the NASA Johnson Space Center near Houston Salary and benefits are competitive and attractive and depend on individual qualifications. Respond before Sept. 30.

> Director's Office, LPI 3303 NASA Road 1 Houston Texas 77058 An aqual opportunity employer

lems.

Academic excellence and the ability to bring forth new ideas are the primary considerations in the selection process. The term of appointment will normally be for twelve month periods (1 October to 25, September); however, exceptions will be considered Candidates may be members of the academic, federal, or private sectors. Where appropriate, Interagency Personnel Agreements are preferable. For further information, contact Professor G.N.K. Moners, Chairman, Department of Oceanography, Naval Postgraduae School, Monterey, California 93940, telephone number (408) 646-2673. Send our icoluminateries to the above address.

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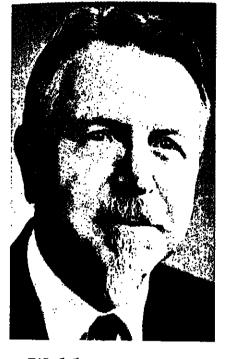
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**AGL** 

## Waldo E. Smith **Receives First** Award of His Namesake Medal



## Waldo E. Smith

This evening marks the first presentation of the American Geophysical Union's Waldo E. Smith Award. While all other AGU awards and honors are given for excellence in scientific research in one or another of the geophysical disciplines, this award is different. The Waldo E. Smith Award is given for dedicated and extraordinary service to geophysics and AGU. It is the principal purpose of this diation to show why it is particularly appropriate that an award for service to American geophysics should be called the Waldo E. Smith Award. A secondary objective, aimed at those present tonight, is to introduce the first recipient of this award, Waldo E. Smith, Executive Director Emeritus of AGU.

Early in 1944, Dr. J. A. Fleining, AGU's General Secretary, approached Waldo with an offer that he become the Union's first fulltime Executive Secretary. The Union then had an employee head count of 11/4, with 2000+ members divided into 8 sections-Geodesy, Seismology, Terrestrial Magnetism and Electricity, Hydrology, Meteorology, Oceanography, Volcanology, and Tectono-

space in the attic of the Carnegie Institution Administration Building. On September 22, 1944. Waldo was duly appointed Executive Secretary of AGU, a position which he held until his retirement in 1970 (the position title was changed to that of Executive Director in 1967). The initial appointment was accompanied by Fleming's strong admonition that "Waldo should not concern himself with building an empire." The 1944 AGU auditor's report, reproduced below in toto, recorded the exact physical dimension of the empire that Waldo had agreed to manage. Equipment owned by the American Geophysical Union

physics—and was housed in borrowed office

One 18-inch primer Burroughs typewriter, ser. No. 60A232450 One 10-inch elite Royal typewriter, ser. No. KHM-2076351 Two 4-drawer, 5×8-inch steel filing cases (gift) Two steel posture chairs One Globe-Wernicke, 2-pedestal flat-top steel desk, 60×34-inch One Triner postal scale, 4 lbs. by 1/2 oz. One Arrow stapler

\$385.24

Using the above as a base, Waldo went to work, and hard work it was by all accounts. For the next 25 years Waldo continued to build AGU, and by the time of his retirement AGU existed largely in its present form and substance. Consider Figure 1 where the growth in AGU statistics for the Waldo era as been plotted. During his tenure the Union grew from 2000+ to 10,000+ members, the staff grew from 21/2 to 40 full-time paid employees, and the journal pages published per year expanded from 482 in 1945 to 17.032 in 1970.

But rather than just considering the numbers of Figure 1 let us translate some of them into entities, and see just what these statistics

have actually meant to American geophysics. In 1959 the Journal of Geophysical Research (JGR) was incorporated into AGU. (Previous , JGR was an unofficial publication of the Carnegie Institute). Phillip H. Abelson and J A. Peoples, Jr., were the first JGR/AGU editors. In its first year under the AGU masthead, and with the help of an NSF grant, JGR published 2460 pages; by 1962 this count had risen to 5398; and by 1970 to

Water Resources Research first appeared as a quarterly in 1965 with Walter B. Langbein as editor and with a total page count of 586; by 1970 this count had risen to 1806 pages with bimonthly issues and was well on its way to being the premier research journal for water

Reviews of Geophysics first appeared in 1963, with Gordon J. F. MacDonald as editor. As a matter of policy the number of pages pub-lished by this journal has always been a fair tightly restricted percentage

pages in JGR, but nevertheless Reviews likewise grew from 665 pages in its first year to 864 in 1970 (by which time it was called Reviews of Geophyseics and Space Physics).
Further, it was in the Waldo era that

AGU's journal translation program started. First came the journals of Izvestiya, Academy of Sciences, USSR (Physics of the Solid Earth and Atmospheric and Ocennic Physics-IZVE/IZVA) in 1957, but by 1965 the number of translation journals being published by AGU had risen to seven. Similar success sagas are associated with AGU's books and monograph series, and all can be said to owe their existence to the friendly environment created for them by Waldo E. Smith. AGU journals and books are highly respected throughout the scientific community, and they are still one of the few real bargains existing in the scientific litera-

Keep in mind that this highly successful publication program was accompanied and orchestrated from 1944 to 1970 by the omtipresent Waldo E. Smith, who acted in this period (depending upon one's point of view) as either the midwife or as the despot, but in any case as the one who always managed to see to it that what had to be done to assure success was indeed done.

In addition to the above list of obvious, major accomplishments, AGU has benefited from some of Waldo's lesser known political and personal abilities. For instance, on October 4, 1957, "Sputnik" appeared, and with it a new, enhanced interest in the science of space. The AGU Council was split on whether or not "space" could be considered as geophysics, but in the end Waldo's pragmatic view "that geophysics is whatever we say it is" prevailed, and by a majority of one vote the Council allowed for the formation of a Section of Planetary Sciences. Dr. J. A. Van Allen served as the first Section President for

Further, in spite of all the growth and ac-

tivity that surrounded Waldo he never forgot that AGU was its members. It is reputed that he knew all the members by name, by sight, and by scientific interest. This must be an exaggeration, but I do know that in my own case I met Waldo very soon after joining the Union because he took the trouble to introduce himself to me at the very first meeting that I attended. Subsequently he never forgot my name, or for that matter the subject of our original conversation. In this regard, I do not believe that I received special treatment, and in fact while researching this citation I received many confirmations of this beloved, ego-boosting ability which Waldo used upon

the membership. However, let us be fair; I did uncover one instance of fallibility. Like a good coach, Waldo always addressed staff members by their last names, and like AGU member names, once learnt these were never forgotten. However, one employee, Miss Chamberlin, married and changed her name. Waldo knew this, but his usually faultless memory-banks exhibited a defect. For 2 years Waldo never addressed that staff member. But the story does have a happy ending, because eventually Helmut Landsberg did manage to teach Wal-do how to pronounce Floloviak, and communication was restored.

But let us return to the business at hand. AGU now has 15,080 members, of whom 65.56 percent joined the Union after Waldo E. Smith's retirement. The AGU staff now numbers nearly 70 of whom only a handful have tenures that date back to the Waldo E. Smith era. AGU's annual publication revenues now total \$5,900,000. We are housed in our own building, and our annual meetings produce presentations that number into the thousands. In summation, when Waldo E. Smith retired in 1970 he left the Union as a vibrant, growing organization.

AGU (cont. on p. 464)

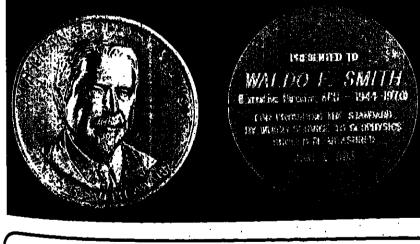
#### **Nominations for 1984 AGU Fellows**

Nominations for Fellowship in the Union are being sought by the Fellows Committee and the Section Selection Committees. Nominees for Fellowship should be scientists who have attained acknowledged eminence in a branch of geophysics. The total number of Fellows elected each year cannot exceed 0.1% of the total membership.

To be considered by the Committee, nominations for Fellowship in AGU must be made on the form below. If more space is needed, attach a separate sheet.

#### AMERICAN GEOPHYSICAL UNION Nomination For Fellowship

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## Nominations for Medals and Awards

William Bowie Medal. Awarded for | of outstanding ability. Recipients must outstanding contributions to fundamental geophysics and for unselfish cooperation in research.

Maurice Ewing Medal. Honors an individual who has led the way in understanding the physical, geophysical, and geological processes in the ocean; who is a leader in ocean engineering, technology, and instrumentation; or who has given distinguished service to the marine sciences. Robert E. Horton Medal. Given for outstanding contributions to the geophysical aspects of Hydrology.

James B. Macelwane Awards. Up to

significant contributions to the geo-

be less than 36 years old. Letters of nomination outlining sig-

nificant contributions and curriculum vitae should be sent directly to the appropriate committee chairmen: Bowie Medal - Eugene M. Shoemaker, U.S. Geological Survey, 2255 Gemini Drive, Flagstaff, AZ 86001; Ewing Medal - Robert O. Reid, Department of Oceanography, Texas A&M University, College Station, TX 77843;

Horton Medal - R. Allan Freeze, Department of Geological Sciences, University of British Columbia, Vancouver, B.C., Canada V6T 1W5; three awards are given each year for Macelwane Award - J. Freeman Gilbert, IGPP A-025, University of California/physical sciences by a young scientist San Diego, La Jolla, CA 92093.

Deadline for Nominations is November 1, 1983.

Name of Sponsor Name of Nominee Personal Data on Nomines siness Address (including Position held) \_\_\_\_\_ e and Place of Birth .... calion (degrees, institutions, major field) \_\_\_\_\_ essional Record (including special honors) \_\_\_\_ nbership in other Scientific Organizations ..... Attach a list of most significant publications (not abstracts, book reviews or papers which have not yet been accepted for publication). Sponsors Evaluation of Nominee Attach a supporting statement which must include: (1) An indication of the length and nature of your acquaintance with the nominee; (2) the Nominee's contributions to the

field to date; (3) your evaluation of the nominee's scientific ability; (4) a one-line citation.

"For ......", summarizing why the nominee should be elected a fellow.

Sponsor's Title and Affiliation

For a list of current Fallows, call or write AGU.

Send nominations for forwarding to the appropriate Section Selection Committee to:

AGU Member Programs 2000 Florida Avenue, N.W. Washington, D.C. 20009 Telephone toll free 800/424-2488 or 462-6903 in the Washington area Deadline: September 19, 1983

nized the adage "that there is more to doing science than doing science" when it established an award in recognition of dedicated and extraordinary service to geophysics. The award, which includes a medal, is to be given no more frequently than every other year. It is most appropriate that these medals to be given by AGU for service to geophysics should bear the likeness of Waldo E. Smith upon one side of them, because for over a quarter of a century AGU, American geophysics, and Waldo E. Smith were synony-

Like William Bowie, who received the first Bowie Medal, Waldo E. Smith is present to receive the first of the medals that bears both his name and his portrait. For service to AGU and to geophysics. Waldo E. Smith has provided the measure and the standard by which all who would follow must be judged. It is with pleasure and with some sense of poctic justice that I now turn to our current AGU President, Dr. J. A. Van Allen, and ask him to make the formal presentation of AGU's newest award, the Waldo E. Smith Award for outstanding service to geophysics.

James R. Wallis

#### Acceptance

As I stand here before you, I feel both very humble and very honored. It would seem that an executive officer of such an organization as the AGU gets much credit that he does not deserve: this accrues not only from his staff, but even more largely from the work of competent devoted officers, committee chairmen and members, and the membership as a whole. It is through them that the executive's efforts are meaningful. I recall that back in 1945 when I arranged my first annual meeting. During the war years, we had to receive permission from some wartime

government agency to hold such a meeting. This was not difficult; earth sciences were already recognized as important to the war effort. The section secretaries and their committees did a creditable job of arranging a good program. Then I had a strange feeling in the pit of my stomach: What if no one but the speakers came? I think that the record will show that some 800 or more came. And I had a feeling of elation as the meeting drew to a close that the meeting had been a success. Thus it was, after every succeeding annual meeting.

But there were other problems. AGU was started by the National Academy of Sciences-National Research Council in 1919 as the U.S. National Committee of the International Union of Geodesy and Geophysics organized by the International Research Council (now ICSU). Originally it had 65 members appointed to cover what was then deemed to span geophysics. During the 1920's, the number was increased to 75, then 100, then 200, and after the financial crash of 1928, the limit was eliminated and most anybody who was willing to contribute \$2 per year was taken into membership. The annual reports and papers presented at the meetings had been published in the NRC series, but after the crash, the NRC cut back on its publishing program and gave the AGU \$400 annually which with the \$2 contributions from the members, growing slowly in number, gave a small working fund.

That was the point that the ingenuity of Dr. John A. Fleming who served as General Secretary of AGU from 1925 until 1947 (and then became Honorary President for Life) came into the picture. He pioneered in the preparation of master copy by typewriter with reproduction by offset which continued into the 1950's, effectively using the limited funds available. The Transactions came out each year, usually in two or more parts. In 1945, when I came into the picture, the

Transactions became a bimonthly. Those old annual volumes contain many papers deemed to be classics and are very choice. Free copies were sent to all members who had contributed and to some 800 libraries without charge,

I never quite heard why or how I became the first executive officer. Dr. Fleming was my mentor, a relationship of which I am still very proud. There was a call for candidates, a selection committee functioned, but in the end, Dr. Fleming made the selection. It was not with rancor, but with real admiration that the organization was sometimes referred to as the John A. Fleming Geophysical Union. He bore a heavy load of work as a volunteer, a devoted volunteer, for over 20 years, editing, corresponding: the prime mover. And he was a perennial optimist, especially with respect to geophysics and most especially the AGU. But the burden became too great, and the membership had grown to about 2,200. He and other officers had sought and received the promise of a grant of \$20,000 over a threeyear period from the Rockefeller Foundation o establish a full-time secretariat, on the condition that another \$10,000 be raised by the membership. So, at the outset, the annual receipts from the membership was 2,200 x 2, or \$4,400. About 90 percent of the libraries subscribed. There was lengthy discussion whether the membership would accept a 50 percent increase in dues, from \$2 to \$3. Academic geophysics had a very limited constituency. Would we lose 90%? Or 50%? Or very tew? The loss, as I recall, was about a normal 2%. Freeborn Johnston, a member of Dr. Fleming's terrestrial magnetism staff, was memberip chairman, and in a bit over a year, he sent out some 15,000 personal notes to prospective members; that brought in some 1,500 new members. And so AGU, always fi-

nancially poor, struggled on. Then along came the IGY. Early in the 1950's, our incumbent president, Dr. Van Alien, and some of his colleagues felt that a third International Polar Year (following the first in 1882-83 and the second in 1932-33) might be in order and named it the International Geophysical Year (IGY). This idea met with enthusiasm abroad, and plans were furthered at the Rome meeting of the IUGG in 1954. The IGY became a phenomenal suc-

Celebrating the 25th anniversary of the IGY at the recent meeting of the NAS, President Frank Press (formerly president of AGU) expressed the idea that this IGY endeavor might truly be unique. It was based on the long developing idea that it was necessary that the earth as a whole should be given serious attention. Dr. Herbert Friedman of the Naval Research Laboratory presented a paper, "The Legacy of the IGY (One Hundred Years of International Cooperation)." There had been the growing feeling throughout the years that the interrelationships in geophysics transcended any one field. Friedman noted that Lieut. Karl Mayprecht of Austria, in the 1870's, proposed what became the First International Polar Year (1882–83) that drew geophysicists together.

Now, coming back to the 1954 IUGG Rome meeting: Clare Boothe Luce was the U.S. Ambassador to Rome. An American reception was held in an embassy home. It was my pleasant duty and honor to present the various foreign delegates to her. From that time on, it seemed to me that Time gave frequent favorable word concerning the IGY ef-

A quarterly, Terrestrial Magnetism and Atmospheric Electricity, had been privately published

by the director of terrestial magnetism of The Carnegie Institution of Washington of Dr. Fleming had that under his wing also When Dr. Merle Tuve became the direct terrestrial magnetism, and thus editor of b quarterly, he changed its name to the Jone of Geophysical Research (JGR) and in 1959 turned this title and the quarterly's good a over to AGU. With the aid of NSF grant, AGU issued JGR monthly, then seminoral and then, as now, three issues a month Books resulting from the IGY work also needed publishing, and there was need to know more about what was going on in go-physics in the USSR. The NSF gave us grant to translate their best geophysical journe New journals were started, as noted by Dr. Wallis. At last geophysics had a real and growing constituency. Each year we were als to save a bit, and we established a resent fund. It had been my hope that a reserve equal to a year's budget might be develope but during the closing years of my incumbers I think that that is about the present ratio.0 course, as the budget went up, due to infa-

creased. Inflation struck with full force just after! retired in 1970, and presented a new set of problems to the officers and to my success which I think were met very well, but I would like to see that reserve ratio increase and a distinct reserve fund established, not for usal operating purposes but to meet new opportunities and challenges. It was on this be sis that I have joined the volunteer effonts raise such a fund. You have received appear regarding this effort from time to time and there has been considerable response. But i is a long hard pull. Earlier we missed opportunities, and other groups have filled some those gaps, tending to disunite effort total the integration of a continuing broad units in geophysics.

tion and for other reasons, the amount is

Dr. Wallis told you about the critical noment when the motion adopting Dr. Van Allen's report to have AGU embrace the environment of the earth in space won by a single vote. It gave me that earlier, sinking feelog again that I got at the time of that fire and al meeting: What would AGU be like today i that one vote had gone the other way?

It has not been all smooth sailing as some of you younger members may feel in the po sent situation. AGU is no longer poor him cially, but neither is it wealthy. AGU has to endowment and has not been in a positions establish a foundation. Meeting current need has always been a real challenge. We need faith and hard work to have the joy of success. Dr. Wallis just told you that two-third of the membership today became member since I retired in 1970. I look at attendees our meetings, and I find many bright young faces. This bodes well for the future Challenges will continue; may you carry on in the traditions of the past to an even greater fa-

A lot more could be said, but those critical years were pretty well chronicled in the Transactions of 1954 (pp. 1 to 47). See if ) ou librarian can dig the issue out.

One regret that I feel today is that my faithful Marthu, my lovely lady for 55 years could not have been here tonight to share this moment of Joy with me. But I am glad that my daughter, Carol, could fly up from Richmond this afternoon to be here.

Thank you.

Waldo E. Smith

A12-07, W. L. Flowers et al.; A12-12, P.

Moose et al.; GP12-14, B. G. Thompson; GP21-04, C. E. Barton; GP22-10, R. J. John son et al.

H22-01, S. Rasmaseshan; HS1B-16, S.T.

O51B-14, R. G. Ingram. S11B-05, B. Valez et al.: S12-05, C. Lemesle et al.; S32-04, T. R. Visvanalhan; S12-01, C. A.

03, J. D. Phillips et al., SA51-05, W. Swider; SA51-05, B. J. Welkins et al. SM22E-22, W. A. Kolasinski et al.; SMAIB

L. D. Smith et al. T22A-01, M. C. Roufosse; T32-09; A. Schedl; T51-03, R. K. O'Nions et al.; T51-06, P. 1751-03 06. F. M. Richter.

M. T. PETRACHENO (Barth Physics Sr EMR. I Observatory Cr., Ottowa, Ontario, Consda Onsgr : Jan Kouba) The Precise Scophymical applications of VLRI captre careful calibration of the phase delay of the thistory by injecting a pulse calibration is normally by injecting a pulse crain into the received

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astronosical signal and then detecting the phase of the Fourier components of the pulse train which lie within the VLBI passband. VLBI applications requiring detailed phase information about the passband or precise knowledge of the single channel group dolay require the simultaneous detection of a number of these tomes. In the case of the Canadian Geophysical LBI System (C2) currently under development, a single 24 MHz channel (12 MHz USB/12 MHz LSB) is used to sequentially sample the IF band. If compatibility with the Mark III VLBI System is desired at the IF level, at least 10 calibrator tomos will active IF level, at least 10 calibrator tomos will active IF level, at least 10 calibrator comes will active IF level, at least 10 calibrator comes will account of the hands. Under these conditions the detection of the phase of these conditions. An alternate approach is proposed. This alternate method requires that the data sampling rate and frequency at the edge of the VLBI passband be integer multiples of the calibrating pulse repetition rate. Index these conditions, the baseband calibrating signal also repeate at the pulse repetition rate and hance it can be averaged. This averaged pariodic seven described the calibrating that respective the calibrating whise train. An thus he would be determine the necessary phase the formation for all tones within the presented. thus he used to determine the necessary pinformation for all comes within the pass

Newly elected AGU Fellows receive their certificates from

John Maxwell (far left) enrolls as an AGU Individ-

ual Supporting Member with AGU Gift Steering

Committee members (left to right) Charles Whitten,

AGU President J. A. Van Allen.

Personal Conics

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Late and Revised Abstracts

Modelands, TX 77380)

Cravast Simplations for Analysis of Geopotential

[.], LEICE I.E WIFET (both at: Goddard Space Flight Centar Greenbelt, MD 20/71)

Computer simulation results for the Geopotantial Valuate Hission (formerly Gravest) have been obtained Which support, security Gravest) have been obtained Wals for gravity smoothy and 10 cm for good baight this abil-wavelength resolution of 1 degree. The

outs a half-margingsty and 10 cm for good baight obsputer simulations were performed with satellite-to-log all degree. The statistic dappler tracking (+1 micros/sea) between two is raidited sapilet tracking (+1 micros/sea) between two is raidited satellites at 150 km in polar orbits and speaked by 100 km in a drag-free environment for a A-test that sate follows: (1) the recovery of spherical states as follows: (1) the recovery of spherical dagges and order 18 gave an accuracy of 2 to 3 orders of speaked between them current knowledge; (2) recovery (5) LAT 20 t.000) in the presence of uncodeded errors fold beight and gravity enough in a local region turned to the region gave an excuracy of 7 cm for 17 blocks within the interior of the region; (3) the littly enough in the interior of the region; (3) the littly enough in a local area containing a trench region space, with use of eigenvalue analyses, constead or the littly enough in a local area containing a trench area of 5 cm for good height and 3 mgs! (or review alpin out of the track region in (3) confirmed the CM. The study which eatiefy socuracy goals of the study under (1) has shown that analysis is (50 to 100) to reduce a significant allowing efficiency Mexical harmonics to high degrees in a global could not to the truncation of the harmonics.

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<u>Sitellite Date and Geology</u>

Earl Droessler, and Morton Rubin.

Tilt at Pinon Flat Observatory, California

Earth scientists recognize the benefit of different perspectives when studying features or varying scales. We have accessed every technological advancement to "see the cods for the trees" or. In our terms, "the mountains for the ductrop. Today, we call it the "synoptic viewpoint." He away progressed through photography from mountaintops, title looss, simplenes, rockets and even the Sylab stellite to multispectral digital images from high-siellite sensors and was experimented with many different sensors will as several sources besides the sun.

The fundamental influence of satellites on the earth kieces comes pracisely from our original objective—
Outning a batter symoptic view! The most important excodary benefits accrued from better spectral resolution (Metall on the ground) and better spectral resolu C. Macdonald (IGPP, UCLA, Los Angeles, CA 90024)
F. Wystt (IGPP, UCSO, Le Jolia, CA 92093)
A. Sytvester (Department of Geological Sciences, UCSB, Senta Berbers, CA 93108)
T. Owen (Bullard Lebs, Cambridge University, Cambridge CB OEZ, England)
R. Bilham (Lemont-Doharty Geological Observatory, Pallasdas, NY 10984)
D.D. Jackson (IGPP, UCLA, Los Angeles, CA 90024) can't discurs.

In this paper we will briefly review the earth science—
The state of the state o

We are operating three 535 mater fluid tiltmeters and a 25 m deep borshole tiltmeter side-by-side at Pinon Flat Observatory, CA. In addition, we have installed levaling benchmarks in a 2500 m loop that includes the tiltmeter baseline. We surveyed parts of the loop tan times, and the entire loop five times since Oct. 1978.

We hope to observe seelsmic tectonic tilting on one or more tilimeters with reasonable agreement. We have not yet achieved this goal, but we have learned much about tilt measurements. The tilimeters agree well at tidal periods (to within a few percent), but not so well at longer periods. During the period 21 Oct 81 through 27 Mer 82, the apparent drift rates ranged from 0.2 to 4 microradians per year. One of the tilimeters suffered from large temperature effects. Recent improvements should reduce the drift rates of some of the instruments. Date collected since 27 Mer 82 appear comparable to the pravious data, except that heavy reinfall caused obvious translents.

Random benchmark motions of up to 1 mm cause the dominant errors in the levaling data. Therefore, we established several special benchmarks anchored at about 10 m depth. Using these monuments, we can estimate the tilt rate to within about 0.5 microredian per year.

Geoid Angmalies over the Macquarie Ridge Complex Indicate an Unexpected Subducted Slab

LARRY RUFF (Dept. Beological Sciences, University of Michigas, Ann Arbor. Hi, 48109) ANNY CAZERAYE (CNES-GROS, 18 Ave. Edouard Belin, Toulouse, 31058, France)

The boundary between the Pacific and Indian plates is presumably coincident with the saismically active Macquaria Ridge complex hereafter; MRC), which lies between South Island (New Zealand) and the Pacific spreading center. Along the nearly morth striking MRC, the RMZ relative plate velocity model (Minster A Jordan, 1978, JGR, 83: 5331) predicts oblique convergence in the north, grading into strike-sip motion in the south. The focal mechanisms of the large recent earth-quakes along the MRC are consistent with the SMZ model. It is therefore puzzling that the physiographic expression of the southermout MRC is the Righert trench; a trough 500 m long that reaches a depth greater than a trough 500 m long that reaches a depth greater than a km as compared to the 3,6 km depth of the surrounding seaffoor. Plate bettonic reconstructions of the southern Pacific indicate that the Hjort trench region has never been a convergent plate surgin. As small troughs do occur along large fracture zones, can we assume that the Hjort trench is a strike-slip feature? We employ goold anomalies, obtained from SERSAT redar altimetry data, to address this question. Previous studies have shown that high-resolution goold profiles across subduction zones and fracture zones are distinctly different. Therefore, observed goold anomalies, across subduction zones and fracture zones are distinctly different. Therefore, observed goold anomalies, it has and sevenenth of subduction zone anomalies. Ingre goold anomalies can be explained by a subducted stab dipping to the mast. Intelligence in the MRC region way not have fallowed these of the pint in the RRC region way not have fallowed these of the pint in the Agreement of the pint and part and adjacent plates.

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Panelists at the Union session on Verification of Nuclear Test Ban Treaties answer questions from the audience

James Tracy (Ertoc Western, Inc.
Long Beach, CA 99807)
Stchael Teubner (Ertoc Western, Inc.
Long Beach, CA 90807)

A simple equivalent porcus used a model is proposed and utilized to investigate the uncertainty of fracture (ice analyses. The proposed sodel is a simple extension of the equivalent porcus used a concept. The malyses address the problems the uncertainty of fracture flow parameters, the definition of fracture geometry, and the definition of preserve geometry, and the definition of primary-fractured connectivity

The fifth attribute to catamate the range of uncertainty in the aggregate pedia limited in utility by the simplicity o

Ocean Sciences

OLZA-O9A INVITED SAR Measurement of Wave Fields with Multiple Directional Components: Observations & Comparison

John F. Vesecty, Martha P. Smith and David J. Mapolitano (Stanford Center for Radar Astronomy, Stanford, CA 94305)

Measurement of ocean wave directional distributions is difficult since pitch-roll bugys provide only crude directional information and wave-rider bugys, no directional information and wave-rider bugys, no directional information at all. Arrays can provide directional information, but are difficult to deploy. Synthatic aparture radar (SAR) images of ocean wave fields can be used to sense wave directional distributions, but the tachnique has important instations. We explore the ability of SAR to measure wave directional distributions using digitally processed images of waves near the Island of Four's (SN of the Shetland (slands). The image contains wavefields with a single dominant component and with multiple directional components queerated by refraction and diffraction near the Island. We compute normalized 2-dimensional spectra of perfinant images to address two issues. First, how well can SAR sense wave systems with multiple directional components? Second, how well does current SAR theory of ocean wave louging describe the degradation of SAR resolution for wave fields with multiple directional components? Ne compare experimental results with the theoretical predictions of Alpars, Ross & Rufenach and of Jain, who addresses the multiple component case specifically.

See Level and Circulation

Meith & Shoupeon (Department of Nova Scotia, Canada B3H 4J1)

Nove Social. Canada RES 411)

See level and transcort variability off the North Atlantic are examined in the frequency rance 6:00 - 0.04 coy (1950-1975). The see level data were recorded at 61 mainland and inland stations of 600 - 185). The Swettern transcorts are detended from monthly wind stress distribution. Each see level esties is corrected for the influence of incest are researce and incest what stress, A criment see level variation is found along the estates bundley of the Butch Atlantic from Newlym (500 to Temerica 1950). Along the east onset of the United States and Canada there are to distinct rections of see level variability, securated by Care Batterns. The variations north of Cape Batterns are otherent with those along the eastern brandary.

Variability of the total seculional greedows to increase montheard. The prace scores are less and then the see level variability in the total seculions in the second are less and then the see level sector. The frequency dependent response of Stoth Atlantia see level.

endent response of Horth Atlantic sea transcri fixelitation is firelly

032A-07A INVITED The Zetwary As A Filter: An Overview

三元/100年,1月2日,建设国际公司等等的政策设置,第二位中央企

I review the procusses that characteries the entury, and describe her they cause the extenty to function as a filter for the calesto it receives from the lead and from the see, 'Tidal currents provide energy for miring saltester from the ocean with freshwater from the river. The resulting salinity distribution driven the non-tidal aspection of reality and the the salinity the salinity that the transmission of the salinity of the salinity of the salinity. This fandbank between salinity

redistribution and gravitational circulation riaces a constraint iffired on the range of satistion is flow and sait concentration in the contraint. In respectively, the restriction also controls the distribution and transportation of suspended sediment, and the deposition of fine printiles within the estuary. The distributions of each and fine suspended into control the behavior of namy non-conservative constituents; their rades of occurrence, transport, and their reservoirs of accumulation. The result of these processes in that the century rediffers mignificantly the strength and the form of the chemical and sendent processes in that the catuary rodifion significantly
the strength and the fore of the chemical and geological signals it receives. Alteration of an extuar's
non-tidel circulation pattern by changing its freshwater input or its geototre produce changes in its
filtering officience. In general, as in estuar, coves
from a highly atractified estuary toward a wall-mised
estuary, its filtering officiency for land-derived
constituents first increases to a carious for
partially-mised estuaries and then decreases.

032A-07B INVITED"

Waldo E. Smith (left), first recipient of the Waldo E. Smith Award,

is congratulated by AGU President J. A. Van Allen.

Aspects of Storm Induced Sediment Resuspension in Coastal Vaters: A Review

N.FRANK BONLEM (University of Connecticut, Marine Sciences Department, Avery Point, Groton, Ct. 06340)

High Boute (University of Connecticut, Harine Sciences Department, Avery Point, Groton, Et. 06340)

The passage of high energy storm events has the potential to affect sediment resuspension in coastal and estuarine waters. Resuspension magnitude and associated mass flux varies as a function of local hydrography and sediment characteristics, basin orientation and morphology, and storm quality. This latter factor depends on storm duration wind stress intensity, dominant wind direction and the speed and direction of storm advance. Historically studies of this multivariate problem have used a lucped paremeter approach in which sediment displacements were simply related to store occurrence without concern for specification of the particular factors dominating cause and affact. The approach provided little information on governing dynamics. Percently improved understanding of two-phase dynamics within the benthic boundary layer and the availability of reliable instrumentation has permitted initiation of field studies of store resuspension. These studies indicate that storm induced resuspension. These studies indicate that storm induced resuspension is typically short-lived and confined to the storm period. This rapid deposition implies settling velocities well in excess of those inferred assuring Stoke's settling. Beyond the short-lived nature of storm resuspension the field data indicate a high dagree of spatial and temporal variability in dominating factors. In open continental shelf waters resuspension in the relative to the tidal stream. Associated interactions with local tidal currents. Resuspension magnitude is governed prisarily hysteric duration and intensity and is relatively insensitive to storm track. Proceeding inshire angultude becomes progressively more sensitive to dominant wind direction as constitute or innation affects fetch and the intensity of wind/wave induced currents relative to the tidal stream. Associated temporal variability increases due to biologically mediated sediment tability increases

Planetology

Transit Time from Mace to Earth

G. W. WETHERILL (DTM, Carnagia Institution of Washington, Washington, D.C. 20015)

Impact experiments and theories suggest that small (< lm) fragments are those most likely to escape Mars. If SNC meteorites represent such small ejected fragments, their transit time to Earth must be \$10 m.y., as indicated by their cosmic ray exposure ages. Valid calculations of "Mars-orossing" transit times have been previously presented only for initial asteroid-like orbits with perihelion mear Mars. These calculated times of \$100 m.y. are not consistent with the observed SNC exposure ages and with the

times of 100 m.y. are not consistent with the observed SNC exposure ages and with the survival of small stony meteorites in the astarcid belt.

Transit times have now been calculated for material sjected at random positions in Mars' orbit at sjection velocities ranging from Mars' agopy velocity of 5.1 km/sec up to 5.9 Km/sec. It is found that for velocities greater than 5.4 Km/sec from 2 to 41 of the ejects reach Earth within 10 m.y. This is about 1/3 of the Mars ejects in this size range that will ever impact Earth.

Earth.

From these considerations it is permissible to interpret SNC exposure ages, as times of sjection from Mars. The principal dynamical problem remains one of cratering mechanics, acceleration of even small frequents to the required valuations.

(com on p. 466)

# <u>Meetinas</u>

Announcements

Environmental

Biogeochemistry On October 9-15, 1983, Santa Fe, N.M., will host the Sixth International Symposium on Environmental Biogeochemistry. As a forum for biologists, chemists, and geologists, the symposium will deal with topics ranging from biological evolution to observations of microbes living in the cracks of stones found in the Autarctic. Microbes living in groundwater, a subject that has not been given much

attention, was added recently to the agenda. On October 8, preceding the first symposium sessions, various field trips will be offered to the Carlsbad Caverns, the Kennecott Chino Mine, Sangre de Cristo Mountains,

and the Jemez Springs.
Contact James A. Brierley, Department of Biology, New Mexico Institute of Mining and Technology, Socorro, NM 87801, for more

### Climate and Environment

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Changing climate and its effects on agricul-ture and environmental quality will be the subject of the 12th Annual Conference of the Illinois Department of Energy and Natural Resources to be held September 13-14, 1985, at the University of Illinois at Urbana: The

conference, entitled "Illinois Climate: Trends, Impacis, and Issues," will deal with such topics as acid rain, the effects of increasing carbon dioxide in the atmosphere, and the relationship of agricultural pests to weather and climate.

For more information contact Mae Maxwell at the Office of Conferences and University of Illinois, Urbana, IL 61801(telephone: 217-333-2883).

## Space and Climate Conference

As part of its blennial meeting, June 25 to July 7, 1984, in Graz, Austria, the Committee on Space Research (COSPAR) of the World Climate Program (WCP) is organizing a spe-cial Symposium on Space Observations for Climate Studies. One of the largest scientific projects of the current century, the WCP is both international and interdisciplinary in

Recognizing that the key component of the WCP's observational program will be based on satellite measurements, the symposium

will focus on the current observations quirements of the program, on results and nterpretations of recent observations, and on future observational requirements. Invited and contributed papers will cover such topics as basic atmospheric variables (temperature, pressure, humidity, winds, and precipitation), clouds, the earth's radiation

budget, the oceans, the cryosphere, land and

surface hydrology, detection of climatic change, and space data (requirements, management, and international coordination). In a special opening session, scientific leaders of the World Climate Research, Impact, Applications, and Data programs will provide a summary of the cur quirements for these programs. The proceedings of the symposium will be published. For further information contact S. Rutten-

berg, Secretary, COSPAR Commission A, NCAR, Boulder, CO 80307. Cosponsors of the symposium include the World Meteorological Organization, the International Association of Meteorology and Atmospheric Physics, the United Nations ronment Program's Scientific Committee on Oceanic Research, the International Union of Radio Science, and the Scientific Committee on Antarctic Research.

## Meeting Report 1983 AGU Spring Meeting Report

Attendees at AGU's 1983 Spring Meeting once again found Baltimore to be a very hospitable, convenient, and delightful place and the Convention Center to be an excellent meeting facility. There were 2100 attendees, and 1400 papers were presented. Changes to the program and additional, late, and revised abstructs are printed below.

#### Papers Not Presented

U32-01A, R. K. Gormick.

GP11-01, D. L. Lin; GP11-02, P. H.

HII-01, S. R. Kshirsagar et al.; H21-05, D. S. Finan et al.; H22-01, P. Blaszczyki,

OllA-08, J. D. Hawkins et al.; O31-05, D. Fornari et al.; O32A-06, F. C. Newman d al.; O32A-07A, J. R. Schubel; O32A-07B, W. F. Bohlen; O32B-05, M. R. Carnes; O4IA-09. R. Ahmad et al.; O42A-10, K. Kim et al.

01, S. M. Day et al.; S42-02, I. R. Samoniu et al.; S42-05, J. P. Todoeschuck et al.; S1-05, I. D. Datius

03, J. F. Fennell et al. SS22-08, J. A. McKinnon et al.; SS42-03.

V11A-12, D. C. Noble; V12A-05, L. M. Le Bei et al.; V22A-02, K. T. M. Johnson et al.; V31B-06, J. W. Prescott et al.; V32A-08, W. H. Zoller et al.; V32A-09, D. L. Finnegan et al.; V42P of the control of the cont al.; V42B-01, J. F. Stebbins et al.

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#### Meetings (cont. from p. 165)

P228-05

M. L. SIGNEE (Jet Propulation Laboratory, California Inatitute of Technology, Passadess, Cd. 91109) B. G. Bills and R. A. Hottinger (Jet Propulation Laboratory, California Inatitute of Technology, Passadens, Cd. 91109)

Happing of lice-of-aight scusioration data reveal gravity highs that appear to be correlated with the labter highland boosemany. The Lopography. The largest ascessly of rice silligate at 100 km silligate an aligned with Maxwell Mentes. Date simulations of theoretical gravity were calculated for savaral profiles under the assumption that the tomography was uncompanied in the tomography was the topography was uncompensated in one case and compensated at various depths in other cases. In all cases the geneatric effect or the theoretical line-of-sight gravity cases. In all cases the geometric effect on the theoretical line-of-sight gravity component produced gravity highs is approximately the same region as the resident at the resident and the supplies. Various model results are compared to the real data profiles and modeling sensitivities to depth of compecsation, surface density, and hithospheric flexure are displayed.

### SPR-Aeronomy

#### Satellite Observations of O 834 A Daygley

S. Kumar (Space Schences Center, Dept. of Physics, Univ. of So. Calif., Los Angeles, CA 90089-1341) S. Chakrabarti, F. Pareace, S. Bowyer (Space Sciences Laboratory, Univ. of California, Borkeley, CA 94720)

Laboratory, Univ. of California, Borkaley, CA 94720)

The O' 334 Å dayglow observations made with the EUV spectrometer on the Air Force setal lite STP-78-1 are interpreted with the use of a radiation transfer model. At 600 km altitude the dayglow intensity was observed to vary with magnetic latitude from 30 R to 508 R in the near andir direction (9 = 140°); the correspondingly large near remith to near nadir intensity ratio of 0.3 - 0.65 over much of the dayside indicates that the O' lons in the topside tomacosphere constitute an optically thick aedium for resonance scattering of 834 Å airglow emission even at this high siciatude. Simultaneous measurements of the O' density from the AE-E spacecraft at 450 km altitude near the equator are used to normalize the STP 78-1 sirglow data. A g-value of 1.1 x 10°8 s-1 is required for the ionization excitation of atchic organ leading to the production of O' atoms in 4p state. The latitudinal distribution of O' density dorived rom the 384 Å airglow data shows a double peak (at 113' lat) surrounding an equatorial trough, characteristic of the opasterial anomaly, at altitudes below 600 km and a single peak at the sagnetic equator above 600 km. At high latitudes (> 20°), the O' densities in the sumer hemisphore are substantially lower than those in the winter

#### 9A21-07 REVISED ABSTRACT

Fon-Noutral Felstivo Volocities in the High Latitude

T. L. KILIEN
P. B. HAYS
G. R. CAPIGNAN (all at: Space Physics Passerch
Liberatory, University of Michigan, Ann Arbor,
HI 48109;
H. A. HERIS
B. B. HANECU (both at: Center for Space Spience,
University of Pass at Balles, Fichardson, TX
75080)

. V. SPENCER H. BRACE

L. B. MARKE L. E. WHARDS (all at a Goddard Space Flight Center, National Atmospheric and Space Administration, Grounbeit, MD 2077))

F-tagion neutral winds and ion drifts have been measured sirultaneously for saveral high latitude parigue passes of the Dynamics Explorer (Dr-2) spacecraft. The neutral wind vector is derived by appropriate reging of the saridional component measured renotely by the Fabry-Farot Interferometer (FF)) with the rond component measured renotely by the Fabry-Farot Interferometer (FF) with the rond component measured (WATS). The first water is derived from is situ measurements by the low Drift Meter (INF) and the Rerarding Potential Analyser (RFA). These measurements mable the ion/meutral difference velocity to be determined at the satellite airticude slong the orbital track. The F-region fictional heating of the ionic and mautral apecies is evaluated and discussed for the passes studied. In particular, ion temperatures inferred from the measured winds and drifts are compared with direct measurements made with the FFA. In addiction, the effect of frictional heating on the occopositional structure of the F-region is discussed waing data from the Neutral Atrosphere Composition Spacecometer (MACS).

#### Simultaneous Observations of Atmospheric Turbulence with 6 and 0.23 meter Wavelengths Radars

K. Jayareera, (Geophysical Institute, University of Alasta, Fairbants, Alasta 99701 B. J. Waltims, Geophysical Institute, University of Alaske, Filrbenks, Alaska 99701

The 1290 Mhz (0.23 m wavelength) radar formerly located at Chatanika, Alaska has been operated in a turbulence-scatter mode for measuring winds and turbulence in the upper troposphere and lower strates phere. Experients were conducted in conjunction with the Poker flat MST radar that operates at 50 MHz (6 m wavelength) and is only 3 kms north of Chatanika.

Oata were obtained simultaneously with both raders Outs were obtained simultaneously with both raders which had the same range resolution (750 m) and nearly common scattering volumes. The objective of the experiment was to determine differences, if any, in measured turbulence intensity of two scale sizes (11,5 cms and 3 m). For both short and long torm averages, we have found enhancements in the level of turbulence measured with the 50 Mmz rader. These differences occurred in the lower stratosphere at 12-13.5 kms altitude. Since the entenne elevations were off-vertical the rader exhous have been accumed due to the state of the state

vertical the radar echoes have been assumed due to tur-bulence-scatter only.

In addition, we have found that the maximum heights observable by 1290 and 50 Max radars were about 18 and 20 kms respectively. Calculations of turbulence inner scale langibs indicates that both radars should be capable of observing turbulence to ruck higher altitudes. We conclude that the upper height limits for useful data are determined by the radars' system sensitivities.

#### SPR-Cosmic Rays

#### SCII-OVA

## 36CJ IN THE MILE PIVER AGUSTER, ALBERGA CROUNSWATER DATING AND VERSPICATION OF FOR FILTRATION

H. Bentley, S. Davis, and G. Svanich, U. of Arizone Dept. of Hydrology and Vater Resources, Tuncon, AZ 85721.
D. Hinore and A. Gorea, Mec. Stat. Ras. Lab., U. of Ecchester, Rockester, My 14627 Lab., U. of Rochester, Rochester, W. 14627
The ACL groundwater dating method was tested on on the Mill Bivor studies againer, Alberta, because flee in this squifer in controlled earliesty by lenkage to everlying and underlying maits and gas expected to be very slow. The act of the Milk River groundwater were used to determine flee juiterns in the squifer. The indeptedly determined flee directions were consistent with those predicted by hydrodynamic data; The SCI agus vere, however, shout four times greater than the hydrodynamic span. This fluence of the hydrodynamic span. This fluence of the size of the flee information that the way have laborated by the hydrodynamic spans of the state of the second of the 35C1 commentations introduce down gradient. This decrease is best explained by lon filtration which would be gapeded to concentrate 3C; but leave the 3C(1/ch)oride ratio unaffected. Under the conditions of lon filtration, the ratio would decay with residence time in the squifer, but the 36C1 souccentration would increase. Thus the 36C1 souccentration would increase. Thus the 36C1 with the squifer is downstay of the Milk River squifer is downsted by lon filtration.

#### 9C12-10A

<sup>36</sup>CL investigation of the great artesian basin, Australia

P. Alroy<sup>1</sup>, E. Bentley<sup>2</sup>, S. Davin<sup>3</sup>, P. Phillips<sup>3</sup>, and D. Elmore<sup>4</sup> 1. AAEC, Pr. Mail Bag, Sutherland M.S.W 2332, Aust. 2 U. of Arlanna, 1 N. M. Tast. of Mining and Tech. 2 U. of Roch. Nuc. Str. Bas. Lah.

As a test of the veildity of the use of 16C1 to date very old ground water, a 36C1 lovestigation was made of the Great Ariesian Basia, which covers about about 1.7 I 106 km<sup>2</sup> in northantera Americalia, about one-fifth of the ocalisest, and is one of the largest the conlinest, and is one of the largest artesian angifer systems in the world. Twenty-fear "CLIficati chloride) ratios were determined for the Jarantic-Cretamons "J" squifer from the rocharge area on the western flanks of the Great Dividing lange west and southwest to Innamischa, in S. Australia. These ratios range from about 110 X 10<sup>-13</sup> in the recharge area to 3 X 10<sup>-13</sup> near janualmona. Incheson developed from the "3cl data are relatively avenly spaced and indicate ground-water valceities and flow directions consistent with the known hydramic parageters of the system. The maximum "Cl appearants of the system. The maximum "Cl appearants area "age" is greater than 2 X 10<sup>0</sup> yrs. The concordance between the "5cl ages and those calculated from hydrodynamic data is a strong endogreement of the fundamental assumptions of "5cl ground-water dating.

## SOLAR CYCLE VARIATION OF THE LATITUDINAL GRADIENT OF SOLAR HIND SPEED AND 5 GEV COSMIC RAYS

G. Nawkirk, Jr. (High Altitude Observatory, Mational Cantar for Atmospheric Research.\* P.O. Box 3000, Boulder, Colo. 80307)
L. A. Fish, and J. Lockwood, (Dapt. of Physics, Univ. of Rew Hampshire, Durham, NH, 03824

Several recent researches have analyzed the properties of the solar wind as they are organized by the heliospheric current sheet. Symphic K-coronometer observations allow one to ascertain the position of this current sheet during much of the solar cycle and to explore the properties of the solar wind and the cosmic ray population of the heliosphere with respect to a "heliomagnetic latitude" expressing distance from the current sheet. We have analyzed the latitudinal variation of solar wind speed and 5 Sev Cosmic Ray flux for the years 1964-82.

tion of solar wind speed and 5 Gev Cosmic Ray flux for the years 1964-82.

For all years during which a reliable gradient can be determined, the solar wind speed increases with distance from the current sheet. The gradient varies markedly throughout the solar cycle and attains a sharp weaking at solar minimum. A negative gradient of cosmic ray flux with increasing he lideafinatic latitude is well established during much of the solar cycle. Incre appears to be no clearly established, systematic variation of this gradient during the cycle. These cosmic ray profiles will be compared with theoretical models based on the classical diffusion-convection and drift dominated theories of cosmic ray propagation.

\* The Hational Center for Atmospheric Research is sponsored by the National Science Foundation.

#### Tectonophysics

12 IA-99

## SIRESS AND STRAIN IN CENTRAL REM HEBRIDES : EFFECTS OF THE SUBDUCTION-COLLISION PROCESS OF THE D'ENTRELASTRAIX YONE

COLLOT Jean-Yves, ORSTOM Noumea, New Caledonia DWIEL Jacques, ORSTOM Noumea, New Caledonia (Sponsor : MAILLIT, P.)

(Sponsor: MAILLIT, P.)

A review of the structural avidences and the shallow satismicity, shows that radiant additional horizontal streams generate a specific compressive stress regime in the Central New Hebrides. Produced deformations show a great resemblance with the Charlet streams are successful to the Central New Hebrides. Produced the Charlet streams are successful to the deformations show a great resemblance with the Charlet streams are successful to the Central Section of a long narrow rigid plastic body i.e. the arc, by a flat rigid die, i.e. the d'Entreasteaux zone. Thus, the central New Hebrides block, which is alsatically beat under vertical streams appears to be, further, plastically deformed and pushed asstward under horizontal streams. Recent upilit of the estern chain can be explained in this model. The strong plate interaction due to the subduction of the d'Entreasteaux agnes is supposed to be responsible for the congressive zones is stress regime across the central part of the arc.

Lamination of the different stress regimes throughout New Hebrides allows to segment the arc into 4 main units:

- the northern New Hebrides: a tensional zone from the northern New Hebrides: a compressive zone between the latitude 14°30 and 17°

- the southern New Hebrides: a tensional zone between the latitudes 19° and 20°30 and the southern most New Hebrides: a mainly compressive zone.

#### T218-00 LHV (7ED

## A Block Tectonics Hodel to Explain Seismicity in Southeastern U. S.

P. TALYANI (Geology Department, University of South Carolina, Columbia, S. C., 29208) R. T. WILLIAMS (esse address)

R. T. WILLIAM (case address)

The sarliest models suggested that saturality in southeasters U. S. occurs on MV oriented presisting tense of weakness, possibly associated with oceanic fracture sones, possibly associated with oceanic fracture sones, bossibly associated with oceanic fracture sones, boraver, sydence for such cosming features was not recognized. We have excended a veriety of date which has enabled us to identify these features, which appear to be associated with observed in a block testonice model. We propose two major RW-SE treading blocks, 60-70 he wide and several hundred he lung, associated at their SE termin with oceanic fracture some. The Blake Spur fracture some (SST2) block can be traced at their SE termin with oceanic fracture somes. The Blake Spur fracture some to the Breward some, where it appears to be offset to SE. It continues as the Easters Kentucky block, which was recently recognized by Mathews (1982). The Worfolk fracture some (SFZ) block can be trued through Va., V. Va., and possibly Fa., where it has been correct the lake Srie-Harylead block by Lavin at al. (1982). Both blacks schild evidence of Mr and MR sovements. The MV movement (\*, 40-60 km) is inferred free offsets in servenagnatic associates, and MR asvements of SSTZ block in inferred from right lateral offsets of A0 km) on the Modec and Breward faults. The intersection of the BST block with Trissaic boundary (sults and the Kinge Momean bett in i.c., as unusued sajor Nr fracture is SV VIrginia identified by Bollinger and Wheeler (1981), and the Bidealor (1981), and the Bidealor (1981), and the Bidealor (1981), and the Bidealor of the Brid block of the Trissaic bone in Kentucky define the leakning of the Brid block of the Trissaic bone in Kentucky define the leakning of the Brid block of the Trissaic bone in Kentucky define the leakning of the Brid block of the Trissaic bone in Kentucky and Thessaic bank defines the leakning of the Tris block of the Trissaic bank defines the lateral of primitively. The intersection of the Tr

T423-06A

Chemical Potential in Crystals under Hon-Bydrostatic

N. 1. BAYLY (Caology Dayarisent, Regenelser Rolytachnic, Institute, Troy, N.Y. 2210) (Sponsor: A. R. Vakson), Giber proposed that if a hospersons cryptal of post component is is contact surgan for orthogonal form with fluids at these different Pressures it would be

nacessary, for squilibrium with respect to the tendency of the solid to dissolve, for the checked potential of that component in the finds to have three different values. Ever since, there has been aperulation about the chanical potential of that component in the solid; the stress state of the solid event to be the same at all points yet, if the component has a recognizable chesical potential in the solid phose at all, that parential seems to vary from point to point.

A new approach to this old problem suggests the failouing; I) any read phase has a finite viscosity, neithor ware nor infinite; solids are just phases of higher viscosity than fluids. 2) Any non-hydrostatic stress attes is a non-department to the chonical potential of a component continues to be definable but is mait-valued; it is a direction-dependent quantity, with three principal values simply linked to the principal extenses. A) At a point, the difference in chanical potential fluonsystal nivious the viscous deformation at that point, in the same way that a potential difference between one point and appeller drives flux.

These suggestions open the way to more satisfactory real ware of simultaneous conditions.

Evidence for Strain-Rate Controlled Cyclic Feldsper growth in Blaatomylonites.

R. J. KHIPE (Dept. Earth Sciences, University of Leeds, Leeds, England, LS2-JJT)

R. P. WINTSCH (Dept. Geology, Indiana University, Bloomington, #7805)
Compositional, textural and microstructural data provide strong evidence for both oscillating strain rates and for cyclic feldsper growth in blaatomylonites from the Moine thrust, Sociland and the Insubric line, Switzerland. These processes are reinted theoretically through chemomedamnical Foedback mechanisms. Compositionnal fluctuations in plagicals as porphyrobles in these back mechanisms. Compositionni fluctuations in plagicalize perphyroblasts in these mylogites reveal complicated moning patterns. Discontinuities in the concentrations of CaO, K2O and FeO mark the boundaries of crement-Ago and FeO mark the boundaries of creacent-shaped overgrowths on opposite sides of -200 pm diameter cores. Concentration gradients indicate (1) normal plagicalese zoning in both cores and overgrowths and (2) an abrupt increase in PCaO(saCa++/aCq+) at the time of overgrowth. These observations can be explained by a decrease in approximate the contraction of the core in app caused by ion exchange on surfaces newly exposed during deformation, which also establishes feldupar supersaturation. Textural evidence for high strain rates and grain size reduction comes from a um muscovite breaches. Evidence for ductile deformation comes from lattice preferred orientations of quartz, and evidence for osaillating strain rates comes from duatile deformation of miorobreach zones. Together the data suggest that opinic changes of atrein rate in fault zones may be related to cyclic periods of crystal growth, which could in turn strongly influence fault rock rheology.

TS 1-05A

#### Tapping of marmas from objuitous mantic heterogeneities NORMAN H. SLEEP (Depts. of Ganlogy and Geophysics, Stanford University, Stanford CA 94305)

Augusta II. Sizar (1981s. or Gaulogy and Geophysics, Stanford CA 94305)

Long-lived betarogenolities in the mantic are indicated by Md-St-Pb isotopic systematics. Explanations for those variations have invoked either distinct layers in the earth that are preferentially tapped by some source regions (such as plumes rising from the base of the mantic) or small-scale helurogeneities which are ubiquitously distributed through the mantic. The meiting behavior in a region with hoterogeneities is modified by lateral conduction of heat. A small (less than a few km), early meited helerogeneity draws heat from its surroundings as it meits during ascent. An increase of meiting by a factor of two over adiabatic ascent is probable in the most satily meited regions. The depleted isotopic ratios of MORE can be explained by selective meiting of heterogeneities with some components before others as material identified with the low \*satily\*-state\* on the ratios of search ascends beseath the ridge. The first component to meit is identified with the low \*saty\_-sway\_-sway\_ from the source region of MURE at the ridge axis. The direction of shear stream which carry it upward but outward away from the source region of MURE at the ridge axis. The direction of shear stream in the upwelling is such that the axis of tension plunges away from the ridge axis. The streamining malarial partially maits at shallow lovels where the direction of dike propagation is more nearly vertical) and tops the last-to-melt MORE component. which is more depleted that the average ascending mantle. For this schoma to work, the MORE component must preduce a greater volume of molt that the other components. The first component to mult is semultimes tapped by velcances away from the ridge axis. At the ridge axis is tapped by the off-axis volumous A third component with high \*saty\_state riting to the ourse and is tapped to some extent on and off axis.

Volcanology, Geoclicinistry, and Petrology.

Volcanology, Geochemistry, and Petrology 45 FA- 15A

#### IIIANIUM : HYGROMAGHAPHILE AND/OR NON HYGROMAGHAPHILE

M M. AZZOUZI (CNEXO-COB, B.P. 337, 29273 Breat Cudox, France); R. BOUGAGLT and R. MAURY (U.B.O. Fac. Sciences, 6 av. Le Gorgeu, 29283 Breat Cedex, France); R. VILLEMAN, J.L. JORON and M. TREUZL (Leb. Geochemistry I 24-25, ES, Univ. P.M. Curie, 4 ptace Jussieu, 75230 Paris Cedex 03, France).

The Parts Codes CD, France).

The hyperosegmothits character of Titanium during the manil to, in good agreewont with setting the manil to, in the setting the manil to, in good agreewont with setting the manil to, in the setting the manil to, in the setting the manil to, in good agreewont with setting the manil to, in good agreewont with setting the manil to, in the setting the manil to,

In order to better understand the distribution of sio, and Alo, tertahedra in three-dimensional network extractures of shuminosilicate salts and glasses, we shares taken them to the structures of binary Sios-GeO2 that the mixing of GeO2 and Sios melter results in a confidence random actions alto the tracture of the part of a confidence random actions in the state of the spectrum of GeO2 in the glass. In the spectrum of Sio-Si and Sio-GeO2 slass the bands corresponding to eastimated and Look cart for a probability of spectrum of Sio-Si and Sio-Ge bonds are observed man 280, 990 and in the spectrum of glass property of the spectrum of the probability of the spectrum of the spectr

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(1) EOS 63, 469 (1982). V4 LB- 12A

The Distribution of Alvali Cations in Big-Silica DEAN W. MATSON, SHIVE. SHARMA and JOH & FRIED (Hawaii Institute of Geophysics, bio. of Fru, Honolulu, HI 9682). APresent address US.

To gain an innight into the effect of alkility, the distribution of alkali cations in silicaria ignaous silicara naita, a systematic facts personal copic investigation of high-silits holds have been performed. It shows that district regions of the glass spense be used to infer regional and localized fit.
Q-species) alkali distribution. High frequests to 1100 cm<sup>-1</sup> and 1950 cm<sup>-1</sup> result from high localized Si-nonbridging oxygen stretchisedut the Q, and Q, species, respectively, where the distribution of the figure oxygen to the first should be carried to the number of bridging oxygen to the first should be considered to the should be considered to the first should be considere glass spectrum indicatos that regions of estat silica-like structure exist in that glass. The With alkali content in the spectra of C. D. with alkali content in the spectra of Or. B. M. silicate glassos, and to persist to higher alkil contents in the spectra of 11 and Da glasso. Be smaller alkali contions are thorstone shown to be setting tendency toward regional clustering in the glassons similar to that producing phase equation over at temperatures well above the matsuchle in: incibility regions of these systems. When regional alkali distribution is strongly depocaon the history of the glass, the 0-species distrion the history of the glass, the G-specier dist tion appears to be dependent only on the glass composition.

V518-12A

The Heat Capacity and Phase Equilibria of Hostory

Z.D. SHAME, G.M. MEIZ, L.M. AROVIIZ, L.J. ISBNE'S disological Sci., University of Michigan, Am ACM MI 48109
I.F. MISTRUM Dept of Chemistry, Univ. of Michigan J.M. VALLEY Bupt of Geology, Rice Univ. Moster II B.S. HEMINGWAY U.S.O.S. 959 Motional Center, Roys, 22102

The least capacity of a natural monificality (as the major, \$5.5, as 0., as 7 has been measured from \$5.5 here, in a international here in the large caloriteatry. Here may be into international here in the previously paint (as 1.3, 1.3) in the property paint (as 1.3, 1.4) in the property paint (as 1.3, 1.4) in the property of the pr

## Geophysical Year

#### New Listings

The complete Geophysical Year last appeared in the May \$1, 1983, Eas. A boldface meeting title indicates sponsor ship or cosponsorship by AGU.

Aug. 8-13, 1985 Ninth International Association of Planetology International Symposium, Second IAP General Assembly, and Second International Planetological Conference, Brussels, Belgium. (Rene J. Defaitie. Royal Observatory of Belgium, Avenue Circulaire 3, B1180 Brussels, Belgium; telephone: 2-375-2484.)

Aug. 10-16, 1985 1983 Field Workshop on a Cross-Section of Archean Crust, Northeastern Ontario, Canada, (Pam Jones, Lunar and Planetary Institute, 3503 NASA, Road One, Houston, TX 77058; telephone: 713-486-2150.)

Aug. 11-16, 1983 Second International posium on River Sedimentation, Nanjing, China. Sponsors, UNESCO and United Naions Development Program. (Dou Guoren, Executive Secretary, The Second International Symposium on River Sedimentation, Nanjing Hydraulic Research Institute, 223 Guangzhou Road, Nanjing, 210024, People's Republic of China; telephone: 33662, cable

Aug. 14-18, 1983 Conference on Glass in Planelary and Geological Phenomena, Alfred. N.Y. (L.D. Pye, New York State College of Ceramics, Alfred University, Alfred, NY 14802: relephone 607-871-2432.1

Aug. 15-27, 1983 Joint Meeting UNES-CO/International Commission of Snow and Ite, Hamburg, Germany. (Sorin Dumitrescu, Director, Division of Water Sciences, UNES-CO, 7, place de Fontenoy, 75700 Paris. France; telephone: 33l-577-1610 x6093.)

Aug. 29-Sept. 7, 1983 International Symposium on Groundwater in Water Resources Planning and International Workshop on Groundwater in Rural Water Supply, Koblenz, Germany. Sponsors, International Hydrological Program and Operational Hydrology Programme. (K. Hofius, Secretary IHP/ OHP, Postfach 309, D-5400 Koblenz, FRG.) Sept. 1, 1983 International Workshop on the Application of Groundwater Protection and Rehabilitation Methods, Kobleny, Germany. Sponsor, International Hydrological Program. (Sorin Dumitrescu, Director, Division of Water Sciences, UNESCO, 7, place de

331-577-1610 x6093.) Sept. 3-4, 1983 Workshop on Past and resent Solar Radiation: The Record in Meteonic and Lunar Regolith, Mainz, Germany. Pamela Jones, Lunar and Planerary Institute. 3303 NASA Road One, Houston, TX 77058; telephone: 713-486-2150.)

fontency, 75700 Paris, France; telephone:

Sept. 5-9, 1983 46th Annual Meteorolitiral Society Meeting, Mainz, Germany. (Friedrich Begemann, MPI für Chemie, Postfach 3060, D-6500 Mainz FRG.) Sept. 11-14, 1988 Distribution System

mposium, Birmingham, Ala, Sponsor, American Water Works Association, (AWWA. 6666 West Quincy Ave., Denver, CO 80235; telephone: 303-794-7711.)

Sept. 12–16, 1988 International Water

#### Supply Association Exhibition and Conferences, Brussels, Belgium. (IWSA Secretatiat, 1 Queen Anne's Gate, London SWI 9BT,

United Kingdom.) Oct.-Nov. 1983 22nd Session of the UNESCO General Conference. (Sorin Dumitrescu, Director, Division of Water Sciences, UNESCO, 7, place de Fontenoy, 75700 Paris, France; telephone 331-577-1610

Oct. 9-12, 1983 Meeting: Association of Earth Science Editors, Houston, Tex. (Painela Jones, Lunar and Planetary Institute, 3303 NASA Road One, Houston, TX 77058; telephone: 713-486-2150.)

x6093.1

Oct. 9-13, 1983 Nineteenth Annual AWRA Conference and Symposium, San Antonio, Tex. Sponsor, American Water Resources Association. (Kenneth D. Reid, Exec-Suite 220, Bethesda, MD 20814.)

Oct. 9-15, 1983 Sixth International Symposium on Environmental Biogeochemistry, Santa Fe, N.M. (James A. Brierley, Department of Biology, New Mexico Institute of Mining and Technology, Socorro, NM

Oct. 17-20, 1983 American Astronomical Society Division of Planetary Sciences 15th Annual Meeting, Ithaca, N.Y. (Stephen J. Ostro, Space Sciences Building, Cornell University, Juhaca, NY 14853.)

Oct. 18-20, 1983 Fifth Conference on Hydrometeorology, Tulsa, Okla. (W.I. Pugs-ley, Program CoChairman, Chief Hydrometeorology Division, Canadian Climate Centre, 4905 Dufferin St., Downsview, Ont. M3Fl 5T4 Canada; telephone: 426 667-4617.)

Oct. 18-20, 1983 Tri-Services Infrared Backgrounds Symposium, Burlington, Mass Sponsor, Department of Defense. (R.E. Murphy, AFGL/OPR, Hanscom AFB, MA 01731.) Chapman Conference on Dec. 5-9, 1983 International Conference Goundwater and Man, Sydney, Australia. (The Services Ptv. Ltd., P.O. Box 1929, Canberra City, ACT 2601, Australia: telephone: 062-49-8015; telex: AA62260 (UNITIS-ACTS1.1

Dec. 5-9, 1983 Symposium on Optimization Techniques for Managing Groundwater and Stream-Aquifer Systems, San Francisco. Calif. Sponsor, AGU Groundwater Committee. (Steven G. Gorelick, U.S. Geological Survey, Mail Stop 21, 345 Middleheld Rd., Menlo Park, CA 94025; telephone: 415-323-8111 x2141 or Manoutch Heidari, Kansas Geological Survey, Lawrence, Kans.; telephone: 913-864-5672.)

Dec. 15-17, 1983 Second Annual Meeting of the Working Group on Mediterraneau Ophiolites, Florence, Italy, (Giovanni B. Piccardo, Instituto di Mineralogia, Petrographia e Geochimica-Università, via La Pira 4, 50121 Eurenze, Italy 1 March 19-23, 1984 Filth Northern Re-

search Basins Symposium and Workshop, Vierumaki, Finland, (Olli Faasanen, Secretary, Organizing Committee, Hydrological Office, Box 436, 00101 Helsinki 10, Finland.) March 19-27, 1984 Sixth Session of the

International Hydrological Program April 1984 CSCE/ASCE Cold Regions Engineering Specialty Conference on Norhtern Resource Development, Edmonton, Alberta, Canada. (Daniel W. Smith, Dept. of Civil Engineering, University of Alberta, Edmonton, Alberta, T6G 2G7, Canada.)

April 1984 Arctic Water Pollution Research: Applications of Science and Technology, Yellowknife, N.W.T., Canada, (W.A. Bridgeo, Bridco Values, Ltd., P.O. Box 3161, Halifax South Post Office, Nova Scotia, B3]

3H5, Canada.) April 3-5, 1984 Interdisciplinary Conference on Meeting the Water Needs of the Southwest, Dallay, Tex. (Michael A. Collins, School of Engineering and Applied Science, Southern Methodist University, Dallas, TX 75275; telephone: 214-692-3060.)

May-June 1984 12th International Congress on Irrigation and Drainage, Fort Collins, Colo. (ICID, 48 Nyaya Marg, Chanakyapuri, New Delhi 110012, India.)

June 11-13, 1984 Symposium on Critical Assessment of Forecasting in Western Water Resource Management, Scattle, Wash. Sponutive Director, AWRA, 5410 Grosvenor Lane, sor, American Water Resources Association. (Gary R. Minton, President, Resource Planning Associates, 113 Lynn Street, Seattle, WA 98109; telephone: 206-282-1681.)

June 24, 1984 International Sympoon Impermeable Barriers for Soil and Rock, Denver, Colo. (A. Ivan Johnson, Woodward-Clyde Consultants, 7600 E. Orchard Road, Englewood, CO 80111; telephone: 303-694-2770.1

June 24, 1984 International Conference on Geomembranes, Denver, Colo. (A. Ivan Johnson, Woodward-Clyde Consultants, 7600 E. Orchard Road, Englewood, CO 80111; telephone: 303-694-2770.)

June 25-July 7, 1984 Symposium on Space Observations for Climate Studies, Graz, Austria. Sponsor, World Climate Program. (S. Ruttenberg, Secretary, COSPAR Commission A, NCAR, Boulder, CO 80307.)

## Natural Variations in Carbon Dioxide and the Carbon Cycle

#### Call for Papers

A Chapman Conference on "Natural Variations in Carbon Dioxide and the Carbon Cycle" will be held in Tarpon Springs, Fla., Janmary 9-13, 1984. The purpose of the conference is to gather geologists who are studying various aspects of carbon cycle lustory together with geochemical modelers and with biologists, oceanographers, and meteorologists who are familial with present and potential future relationships among the carbon cycle. atmospheric CO<sub>2</sub>, and climate.

The potential climatic effects of anthropogenic CO have stimulated a worldwide prograin of interdisciplinary carbon cycle research. At the same time, geologists have intensified their studies of such global processes as carbonate dissolution, organic carbon buri-al, sea level change, and other mechanisms that may have caused or reflected carbon cycle changes in the past. These largely independent trends in environmental and geological research are fundamentally related. The geological record shows a significant degree of carbon cycle variability before any human influence, suggesting the possibility of past at-mospheric CO<sub>2</sub> fluctuations. What caused the carbon cycle variations? How were they relat-

ed to atmospheric CO2? Were they associated with climate changes consistent with the CO2/ climate predictive models? To what extent could natural variations contribute to the present CO2 budget? What are the long-term geochemical implications of tossil fuel CO2? These are among the questions that will be discussed at this conference.

The conference will consist of both invited and contributed papers. It is expected that about two-thirds of the participants will be geologists and about one-third will be from the CO2 research community. One or two meeting sessions will be devoted to overview talks by experts on the application of ocean modeling, climate modeling, and biosphere modeling to COs research. The remainder of the conference will emphasize the geological record. Because studies covering different time scales are often concerned with different kinds of processes and data, the meeting will be organized around six "time slices": (1) the last 2,000 years, (2) the last 20,000 years, (3) the last 2 million years, (4) the Cenozoic, (5) the Phanerozoic, and (6) the Precambrian. These categories are not meant to be rigidly restrictive; for example, the third category might include Pliocene hydraulic pistou core data, and the fourth might include the Cretaceous/Tertiary boundary.

The 5-day conference will include morning and evening sessions, with afternoons devoted to informal discussions and recreation. In order to encourage interdisciplinary discussion, there will be no paradlel sessions, and oral presentations will be allotted at least 30 minutes each. If necessary, space and time will be available for poster sessions. All of the oral presentations, and perhaps some of the poster presentations and summaries of discussions, will be published by AGU in a Geophysical Monograph within one year of the conterence.

Arrangements are being made for grants to cover travel and conference costs for a number of attendees, including several students. Students wishing to apply should write to AGU by September 15, 1983, giving educational background, reasons for wanting to attend the conference, and current interesis. Awardees will be selected by AGU in conjunction with the program committee. All who are interested in attending and in receiving later information circulars should write to Carbon Cycle Meeting, AGU, 2000 Florida Avenue, N.W., Washington, D. C. 20009 (telephone toll free: 800-424-2488 or, in the D.C. area, 469-6903).

To submit an abstract, tollow the abstract format published in Eos. June 28, 1983 There will be no abstract charge. All abstracts should be sent to E. T. Sundquist, U.S. Geological Survey, 431 National Center, Reston. VA 22092.

Abstract Deadline: September 15, 1983 Program Committee: E. T. Sundquist (co-convenor), U.S. Geological Survey; W. S. Broecker (co-convenor), Lamont-Doherty Geological Observatory: R. Bacastow, Scripps Institution of Oceanography; E. J. Barron, National Center for Atmospheric Research; W. H. Berger, Scripps Institution of Oceanography; T. C. Moore, Jr., Exxon Production Research Company; H. Oeschger, Physikalisches Institut, Universität Bern; S. H. Schneider, National Center for Atmospheric

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## Aeronomy

Olio Agronosy (Composition, Atomic or Molecular)
LEMANGEMENT OF HEAVY OZONE IN THE EARTH'S
Jack A. Raye (Plasma Physics Division, Maval
Lemanch Laboratory, Mashington, D.C. 20175) and
The Physicia enhancement of Internative Mass The Positive and an examination of inotopically heavy of the preferential photo-considered of the preferential photo-considered of heavy oxygen (\*\*0;) is only model we show that the rapidity of the stange watching the preference of the preference

180 + 3202 \$ 160 + 3402 Prevents any Anhancement at stratospheric deparatures, Since in situ mass spectrometric descriptions nuggest that much an ordered and sister one is last with a parador. Fossible isospically specific photochemistry of oscon, are to be noncompetitive with the exchange in the stratosphere, tootope serichment).

Gamphys, Ras., Orem, Paper 303992:

#### Electromagnetics

UT-20 Elactromagnetic theory
UT-20 Elactromagnetic FIELDS PRODUCED IN A
CONDUCTING MEDIUM OF INFINITE EXTENT BY LINEAR CURRENT SOURCES OF INFINITE EXENTH
A.S. Inan (STAR Laboratory, Stenford University, Stanford, California, 94305), A.C. FrasarSmith, and O.G. Villard, Jr.
A previous analysis of a linear current
source of finite length smbadded in a conducting medium of infinite extent is extended to
linear current sources of (1) infinite length,
and (ii) semi-infinite length, Electric and
magnetic field expressions are derived and the
results are numerically evaluated for frequencles in the UT-26EP bands. For convenionce,
some of the results are presented in a dimen-

cles in the ULF/BLF bands. For conventonce, some of the results are presented in a dimensionless form. A comparison is made between the electromagnetic fields produced by linear current sources of finite and infinite length and it is shown that there is a reletive enhancement in the electric field near the source of finite length. It is also found that an optimum frequency exists for the electric field produced by linear current source of infinite length at which the field amplitude is a maximum at a fixed observation point. Some practicel applications of our results are suggested.

0716 Media Effects CALCULATION OF ICE DEPOLARISATION ON SATELLITE BADIO PATES A. Tuolakis and W. L. Stutuman (Virginis Tech. Electrical Engineering Department, Electronics, VA 24061)

gested. Rad. Sci., Paper 361083

Electrical Engineering implements of the presented for calculating the dapolarization of ice clouds. Rayleigh eachering from single particles is need. A general theory is introduced that includes distributions of ice particle shapes and arientation ongles for both single and switchip scattering. It is shown that the more accurate suitiple scattering formulation yields XPD values significantly worse than that for single scattering over the 10 to 10 DHS band for high ice content. Comparisons are bads to measurements using the Red. Sci., Paper 390968

07.36 Media Bifedes
THE HUPACT OF ICE ALONG SATELLITE TO BARTS PATHS
ON 13 GRE SPONARIZATION STATISTICS
W. L. SLUTERS (VIRIALE Tech, Electrical,
Englineering, Deportment, Electrical Programmering, Deportment, Electrical
O. W. Boatlam, A. Trolakie, and T. Pratt

This paper summarizes measurements of ice depolarization used using a unique facility consisting of a dual cita (7.) he site specing), dual circularly polarized, low elevation angle (10.7°) receiving system for the Simio 11.6 CHs beacon. In several cases marrly simultaneous disturbances were observed on both sites, indicating large for clouds were present. Significant depolarization (XPD on low as 10 dB) in the absence of attenuation occurred relatively frequently. However, the impact of the ice on the XPD statistics for a six month cina paried was small.

077) Remote Sensing RADIOMETRIC SENSING OF BIOLOGICAL LAYERED F. Bardati, D. Solimini (Dipartimento di Ingegneria Eiettronica, Università di Roma-Tor Vergata, 00173 Rome, Italy).

The reineral of temperature profites in tayared living The retrieval of temperature protocolors to the considered. The brightness temperature of a layered biological structure is expressed as a function of the thermal distribution in the tissues for different microwave fraquencies, engine of observation and polarization of the amilited waves. A coherent approach to the continuous fraquencies, engine is followed to obtain the redistive transfer problem is followed to obtain the weighting functions in closed form for use in the inverse problem. The extraction of the thermal profiles from brightness data sets by use of Kalman filtering is finally discussed, with particular reference to the detect of deep thermal anomalise. (Thermal emission,

#### Geochemistry.

1410 Chaptistry of the Atmosphere
TEMPORAL BISTRIBUTIONS OF RADIOSTRONTIUM ISOTOPES AND
RADON CAUGHTERS IN RAIMMATER DIRING A TRADECTSTORM
L. A. Sprikffeld, J. D. Akridge and P. K. Kurode
(Department of Chamistry, University of Arkanas,
Fayetisville, Arkanasa 7201)
The concentrations of "15", "FS", 1876, 11976,
2199, and 2190 mears measured in sequentially sampled
raimmater during a thundertopro which occurred at
Fayetisville, Arkanasa; on 29 January 1981. Approximutaly concordant mean residence tiest ranging from 43
to 136 days were obtained from the observed ratios of
#85r/18sr and 21970/71Pb. The 21276/718ps ratio was
found to correlate negatively with the 11890/718ps.

ratio. The variation of the <sup>212</sup>Pb/<sup>214</sup>Pb ratio appeared to have resulted from turbulent mixing of air masses and increased sharply after the time the rainfall reached a peak value.

J. Geophys. Res., Green, Paper 300667

### Hydrology

rell as upstream depending upon the cause of lagradation. The causes of downstream progra Independent fiver channel veriables, such as impressed in ustar discharge, decrease is airs of bed-material, and decrease is bed-material discharge. The causes of spateses progressing degradation are all related to an imposed intercase to river slope which can occur as a result of natural river behavior or by man-made changes. Study of various case blateries ledicates that river slopes are increased by invering a bess level, by decreasing the length of a river or by removal of a control point. Case kistories also about that downstress and upstress progressing degradation can act in combination along a river system; downstress progressing degradation slung the main stress of a river system; and the second of a river system; and the second of a river system can initiate upstress progressing degradation stong the progressing degradation of the system of the second of a river system; and initiate upstress progressing degradation on a tributary.

3180 Water Quality

SAMPLING FRICTUREST FOR WATER QUALITY MONITORING

D. Campy (Yaralty of Commerce, University of Brisish
Columbia, Variouser, B.C., Canada Yof 195), F.N. Nesset
and D.H. Jyano

Selenting the sempling frequency is one of the most
impercent tenks in the design of a regulatory water
quantity monitoring program. This paper proposes two
quantitative measures of the effectiveness of
different sempling frequencies; these measures are
intended to be used at the preliminary program design
stage. The goal of the program is assumed to be the
detection of violations of vater quality standards.
The first measure, M', gives the aspected proportion
of violations that will be detected. The second, M'',
is the ratio of the expected number of violations,
Mitimestical expressions for both statistics are
developed. It is shown that by sating the svarage
smopling interval equal to the svaring the svarage
spatial interval equal to the svaring duration of a
violation, the expected number of violations sints
the errors damed by similing some violations sints
the errors damed by similing some violations sints
the errors damed by similing some violations of the Mater Resours Ree, Fapor 391040

1710 Boundary Layer structures and processes
USE OF LONG-LIVED RADON DAUGHTES AS INDICATORS OF
EKCHANGE BITWEEN THE FREE INDOSPHERE AND THE
KARIHE BOUNDARY LAYER
KARIA Ames Research Contor; Hoffelt Field, LA 94035)
Fitures and exchange confidence are derived for
the transpart of ""Gr. 210pp, 21086 and 210po between
the free tropospheror and the series benudary layer,
and between the boundary layer and the sea surface.
Radiomoulids concentrations previously messired mean
Havaii are used in the derivations. Values obtained
for the free troposphere/boundary layer exchange coafficient (expressed as a pictor velocity) usee 183,
226 and 201 m d-1 for 210pb, 210ai, and \*0fr, respectively. The magnitude of the local mea-surface
mource of 210p is also derived. (Atmasphatic
radiomoulides, methos atmosphere, free troposphere/
boundary layer exchange).

3715 Chemical composition and chemical interactions THE CONCENTRATION OF AMERICA IN SOUTHERN OCEAN AIR G.P. Ayers (Division of Atmospheric Research, CSIRO, P.O. Box 77, Mordising, Victoria, 3195. Australia.) and J.L. Gras

and J.L. Gram

Monsurcommis of armonia gas concentration at Cape Grim

Monsurcommis of armonia gas concentration at Cape Grim

(40°41'5., 144°41'E.) have been made during six field
expeditions between February 1978 and May 1980. For
this constal site a clear distinction between scrittine
and continuously winds was evident in the observed
armonia concentrations. Mile continental winds gave
concentrations comparable with those generally reported
in the northern headaphere ("I ug n.", 517), maritime
winds gave such lower concentrations (seen 0.00 µg n."

STP). No large someonal trend was apparent in the

latter data.

1715 Chemical Coopenition and Chemical Interactions
NURAL MEASURDENTS OF THE CHRICAL COOPENITOR OF
ARROGNEP PARTICLES IN THE PARTERN U.S.

G. T. Wolff (Environmental Science Department, Constal
Nuture Research Laboratorius, Warram, Nichigam, 48090).

N. A. Kelly, K. A. Furman, and Mark L. Morrissoy
Quantitative measurements of particulate composition
were made at three rural sites; in control South
Debate, on the Louisians Culf Coset and in the Blue
Ridge Mountains of Virginia. The first two sites
were selected to determine beckground concentrations
in continuatal polar and marities cropical air messes,
respectively, which affect the destorm V.S. during
the ousmor. The Virginia site was selected as a
remptor site, downwind of the midwatern source areas.
The Nouth Debate data established the background concentrations. Them concentrations were aiming to
the levels in louisians when air parcels strived from
the Gulf of Marico withour recently passing over the
U.S. Lavels of fine particles (diameters less than
2.5 km) were highest in Virginia and were dus chiefly
to suitate. Jung trajectory and statistical analyses,
it is shown that the realdence time of an air parcel
over the midwaters cource area was the next important
variable in descripting the sulfate levels in the Blue
Ridge Mountains.

J. Goophys. Res., Green. Paper 19984

3715 Chemical corposition and chemical interactions AM INVESTIGATION OF SULFATE PRODUCTION IN CLOUDS USING A FLOW-THROUGH CHEMICAL REACTOR MODEL APPROACH MIN-Sun Hong and Gregory R. Carnichael (Checkel and Material's Engineering. University of lows, lora City, lows 52242).

A flow-through chemical reactor model is developed to describe the mass transfer and chemical processes that atmospheric gases undergo in clouds. The radel Includes the siruitaneous absorption of 50, Mil. O., NO., NO., CO. and M.O., the accompanying dissociation and oxidation reactions in cloud water, considers solution electral-meutrality, and includes qualitative paramoterization of cloud microphysics. The model is used to assess the importance of the oxidation reaction M.O.-S(IY).

O.-S(IY) and S(IY)-Mn\*\* catalysis, and the effects of cloud parameters such as drop size, rain intensity. Inquid water content and updraft velocity. Both precipitating and non-precipitating clouds are studied.

Model results predict sulfate production rates varying from 18, hr to 2305/hr (expressed in terms of gaseous SO<sub>2</sub> convesion rate). The actual rate is highly dependent on the chemical composition of the uplate air and the physical conditions of the cloud, Model results also show that both the H<sub>2</sub>O<sub>2</sub> and the O<sub>3</sub> oxidation reactions can be significant. J. Gaophys. Fes., Green, Paper 100777

J. Csophys. Fes., Green, Paper 10777

J720 Climatology
SUNFACE Alberd DATA FOR CLIMATIC MODELING
A. Henderson-Sallers (Department of
Geography. University of Liverpool, P.O.
hox 147, Liverpool, U.X.), H. F. Wilson
The Climate system is driven, primarily,
by energy absorbed at the surface.
Surface albeds sensitivity is incorporated
into all types of climate models and
changes can lead to large feedback
effects. For example, alterations in the
extent and/or state of the cryosphere and
large-scale modification of vegetation
cause significant parturbations in climate
rodel results. The specification of
surface albeds in general circulation
climate models (GCMs) differs. An
improved and system directed abbeds data
set is urgently required for climate
modeling. It is likely that the most
sepropriate means of achieving consistent
and credible surface albedos is by using
well-designed satellite surveillance to
suppent global inventories of soils and
vegetation. Nowever, retrieval of surface
albedo values for all sky and surface
conditions from satellite observations is
difficult. Atmospheric distortion is
sepecially hard to remove. Some of the
sensitivity of GCMs to surface albedo
values may be the result of inadequate
parameterization of other climatic
components. The accuracy of information
demanded by climate modelers could be
reduced and rade nore consistent.
Recommendations are made for the
implementation of a new global-scale
observational programme with the aim of
providing surface albedo data at an
accuracy of 10.05 within 5-10 years.
Investigation initiation is urged. (Climate
models, satellite surveys, surface
albedo).
Recombys, Esser phys. Parts belose

Rev. Goophys. Space Phys., Paper 381085 1735 Electrical phanomena (Lightning)
POSITIVE CLOD-TO-TO-TOOND LIGHTNIN RETURN STROKES
W.H. Reasley (Department of Theatrical Engineering,
University of Florida, Cainesvilla, FL 32611, H.A.
Uman, D.H. Jorden and C. Ganasvilla, FL 32611, H.A.
Esseveral recent papers have reported positive cloudto-ground lightning, but, in our opinion, none provides
sufficiently direct evidence that positive return
acrolus occurred in any given case. Here we present
observations that plaking demonstrate the occurrence
of positive return strokes in a convective thousderstorm
in Florida in August, 1982. These observations consist
of vareforms of electric field correlated in time with
hight pulses received through a nerrow collinated slit
sland about 1.2 degrees above a level plans and with
videoteps records of lightning chanals. We studied
lightning during on 15-minute interval at a range of
20 to 40 km. During this period we recorded timerorrelated waveforms from three positive return strokes.
The 102-90% rise times of the slectric fields, 1-5 µs,
and of the light pulses, 3-5 µs, was similar to those
of negative raturn atrokes in the same acoum. The
light signals of the positive return strokes began 2
to 8 µs after the electric fields, consistent with
tuturn-stroke speeds of about 10<sup>5</sup> mo<sup>-1</sup>, a value conperable to appeads of about 10<sup>5</sup> mo<sup>-1</sup>, a value confields in 5.

J. Geophys. Res., Green, Paper 300611

1735 Electrical Photosena (Thoderstore Electrification)
TRANSIENT MORDHM-RETROLDS FREEING POTENTIALS
J.H. Carantl and A.J. Illingworth (Dept. of Physics,
DMST, Manchaster MGO 140, UK)
Woltman-Raymolds Irasains potentials may result in
thunderstorm electrification or eigenefic presipitation
static, Laboratory experiments on the development of

these freezing potentials when bulk supercooled solution freeze, and when reindrops and cloud droplets freeze on impact with an ice surface, show that:

a) Any potentials developed are very much smaller than the published values for the quesi-static case.

b) In situations of stmespheric importance the drops will be supercooled, and such solutions are very much less efficient in developing potentials than more supercooled ones. coled ones.
c) Cloud droplets fraeze very rapidly and if any

freezing potential advalops during this time them it decays in less than Semers and is statistically unlit to affect charge transfer in subsequent collisions wi to attact charge transfer is superposed to the conclude that in the atmosphere Morkman-Reymolds potentials do not influence the charge transferred by colliding precipitation particles and briefly consider other relevant mechanisms. (Thunderscore electrificarion, charging, precipitation static).
J. Geophys. Res., Green, Paper 300940

3740 General Circulation
LARGE-SCALE ATMOSPHERIC MIXING DERIVED
FROM NERIDIONAL PROFILES OF ET-53
V. Vaisa, A. Sistchus, B. Stockburger,
H. Sartorius (Max-Planck-Institut für
Kornphysik, Außenzetlls FraiburgSchaufneiand, Rosastr. 9,
7800 Fraiburg i.Br., V. Germany),
K.G. Nünnich

7800 Freiburg 1.Br., W. Germany),
K.O. Munich
Two north-south sections of the
atmospheric concentration of Kr-35 are
presented. The noet attiting feature of
these sections is a large concentration
Jump at the respective geographical
position of the Intertropical Convergence. Horthern hemispheric residence
times of 1 and 1.7 yes resp. are
cativated from the Kr-85 sections. The
mean slope of the Kr-85 sections. The
mean slope of the Kr-85 sections. The
mean slope of the Kr-85 sections of a
continuous Kr-85 record from two
stations in 47.9° M. 7.8° Z (difference
in sittude : 1000 m) show a mean concentration increase par year of
O.5 pc[/m], as apparent measured variability (amplitude 1 - 2 pcf/m²), and
numerous peaks. The peaks originate
from European sites. The yearly contribution of this (these) source(a) to the
global Kr-85 discharge is at least left.
The spearent sessional variability of
the Kr-85 concentrations is tentatively
explained by the sessional variability
of the varical mixing of the
atmosphere.

J. Goophys. Res., Green, Paper Sciliz

J. Goophys. Res., Green, Paper 3C11|2

J. Goophys. Res., Green, Paper JCIII2

1740 Seneral Circulation
ROTATING FULID EXPERIMENTS WITH AN ATMOSPHERIC GENERAL
CIRCULATION MODEL

J. E. Geisler (Department of Meteorology, University of
Utah, Salt Lake City, UT 84112), E. J. Pitcher and R.
C. Malone

The traditional apparatus for rotating-fluid experiments in the laboratory is an annular container of fillid
situated on a turntable. A fundamental difficulty in
applying to atmospheric circulation problems the knowledge and understanding of the behavior of rotating fluids gained from these experiments is the geometrical
difference between a rotating annulus and a rotating
spherical shall. With a view toward Identifying features of rotating fluid flow that are dependent on the
geometry, we have undertaken rotating-annulus-type expariments with a numerical model in spherical coordinates. Rather than construct and test a model specifically for this purpose, we found it expedient to modlify an existing general circulation model of the atmosphere by removing the model physics and replacing the
lower boundary with a uniform surface. We present here
a regime diagram derived from these model experiments,
interpret its major features, and contrast these with
the major features of rotating-annulus regime diagrams.
A nerrow region where one or two zonal wavenumbers are
dominant is found within the wave regime. In contrast
to the situation in the annulus, there is no upper symmetric regime in our results, and wave activity at Ion
rotation rates appears to be caintained by bardtropic
rather than baroclinic processes. (Rotating-fluid experiments, geophysical fluid dynamics)
J. Geophys. Res., Green, Paper 201079

3740 General Circulation LORG AND MEDIUM-SCALE WAYES IN THE LOWER STRATSOPHERE FROM SATELLITE-DESIVED MICEOWAYE MEASUREMENTA Wan-bi TV, Sussell I. Martin and John L. Steaford (Physics Department, Jown State University, Ames, Jown 50011)

(Physica Department, Jose State University, Aces, Jose 15001)
Global grids have been constructed from high-quality TERDS-B Microwave Soundar Unit messurements which closely approximate the 30-150 mb geopotential thickness. The grids compare favorably with conventional satiyana. Grids for January 1779 are spectrally satiyand by Fourier transform for sonal avenumbers 1-10 over latitudes 80% to 80%. Both time-mean and transient medium-scale were are discussed in some detail. In the time mean, wave I dominates all northern latitudes. In equatorial regions were I slee in dominant, but a secondary spectral peak is noted at ware 4. The most remarkable feature seen is a strong, maintened were structure with eastward wovesent in Southern (summer) mid-latitudes. Zonal avenumbers 5 and 6 have periods of about 10-15 days and 5 days, respectively. These results provide independent corroboration of such atructors remarkly reported by sweets lavestigators. The acchains by which the understood.

J. Gaophya, Res., Green, Paper 300800

3755
STAR LINE-OF-SIGHT REFRACTION OBSERVATIONS
FROM THE ORBITING ASTRONOMICAL OBSERVATIONS
FROM THE ORBITING ASTRONOMICAL OBSERVATORY
"COPERNICUS". AND OFDUCTION OF STRATOEPHERIC
STRUCTURE IN THE TROPICAL REGION.
R.L. White (C.S. Draper Laboratory, Cambridge,
HA 02139), N.E. Tanner and R.S. Polidan.
Right-time abservations from the Orbiting
Amight-time abservations from the Orbiting
Amight-time abservations from the Orbiting
Amight-time abservations from the Urbiting
Irregularities of the atmosphere are presented.
Irregularities of the measured refraction angle are interpreted to be the result of the
thermal fine structure in the stratosphere.
The observations are very sensitive to herizontally stratified structures with temperature variations of 2 to 58K in narrow vertices
bands, typical for the boundaries of wind
ducte. This optical technique of remote sensing of atmospheric structure is particularly
applicable to the stitude region of 2 to 49
km, where the vertical soundings by MMT -the where the vertical towndings by VMF and UMF tend to exhibit inadequate sensitivity. J. Geophys. Res., Green, Paper 300594

J799 General Mateurology
A FREQUENCY DOWAIK ANALYSIS OF TRENDS IN DOSSON
TOTAL OZONE RECORDS
P. Bloomield (Dept. of Statistica, P.O. Box 37,
Princeton University, Princeton, M.) OSB441
G. Onhiert, M.L. Thompson, S. Zeger,
A frequency dowain statistical model for the
Dobton total column ozone data is introduced.
This model extends variance-components analysis
to the time series case and incorporates both
temporal and spatial association found in the
ozone possibly associated with chlorofluorocarbons to be a 0.1% increase from 1970 through
1979, with a standard error of 0.55%. This
estimate is most sensitive to long term phenomene
in the data and is relatively innemsitive to
phenomena with time scales less them 2 years.
J. Goopbyn, Res., Green, Paper 201026 J, Gaophys. Res., Green, Paper 301026

Mineralogy, Petrology, and Crystal Chemistry

A250 Paragements, patrography and patrogenesis CRAMITE PETERLOOF, LLIMDIS DEUP BOLE Diverd G. Lidiat (Geology and Pienatary Sciance Department Datwardty of Pittsburgh, Pittsburgh, PA 1,250), Roger E. Denison
Two bain becament granited types have been identified in core samples from the Illinois deep hole project. The main warlety is a middless to comment of patroctian, parthics and less openedly dearty and selected in parthics and less openedly dearty and selected in parthics and less openedly dearty and sedia blasicolose in a matrix of these middless and

biotite, muscovite, fluorite, aignetite, fluorite, sircon, hornblonde, aparite, mphone, constitu, rutile, and clinopyroseno (volict). The texture is typically bypidiomorphic grandational to recrysinilized zanomorphic. The second cain granuitoid, which accurs in the upper part of hole UPI-1, is a fine-gratical granbelastic to topidoblastic gnolastic Atanite that is distinct from and possibly older than the non-folidated granite. The acctures of both tacks have been modified by a mild cataclastic shearing that has partially recrystallized the barn sunceptible of interest phases. This fracture planes that cross-cut the seriler foliations are common.

Histoprobe analyses Indicate that blotitos in the gnaissic granite are chanically distinct from those in the granite. Silectics in the gnaissic granite have higher Fe/Fe + Mg taxlo, FeO and Alpin, and lower Mgo and \$100. Reflection microscopy and microprobe snalpses indicate that the oxide phases in the two racks are also different. The oxides in the granite are asymmetric and ilemite, whereas breakites and pseudobrookite occur in the gneissic granite. The biotite and Fe-Ti oxide date represent additional evidence in support of the fact that the granite. The biotite and Fe-Ti oxide date represent additional evidence in support of the fact that the granite and granite are distinct rocks and probably not part of a continuous co-magnatic sequence.

Major olesent chamical analyses indicate that the granites have self-inities to anarogenic repakivi granites. The finities to anarogenic repakivi granites was efficient and sensity sequences. The granites in the deep-holes are high in \$101, silesis (Nago + Xyo), F. Feo/Mgo] low in Altin, FeO, FaQO, TiOz. MnO, and PaOs; and slightly low in MgO and CaO.

Magnetic susceptibility and density measurements correlate generally used with the susceptibilities content packed in the susceptibility and density logs. Magnetic susceptibility and density logs. Magnetic susceptibility and loss of the packed packed to the packed on the packed

Oceanography

Oceanography

4705 Boundary layer and exchange processes
HEAT FIDERS OVER THE EASTERN TROPICAL PACIFIC AND
ASPECTS OF THE 1972 EL NIRO
R. E. Reed (Pacific Harine Environmental Laboratory.
NOAA, Seattle, Washington 98105)
Recently evaluated flux formulas were used with an
addited ship-of-opportunity data set for the 1970's
decade to derive estimates of the individual surface
heat fluxes and the total or net surface snergy eschange
for the esators tropical Pacific. Absorbed solar
radiation is the dominant best flux in the region, and
latent heat saxhange is the second most important
component; total cloud cover and wind speed are
generally the most significant atmospheric variables.
Over much of the area, the semual axcess of net surface
flux appears to be balanced by heat advection in the
South Equatorial Current. Although the seasons! cycles
of sea surface temperature seem to be produced by
variations in mat surface flux over parts of the area,
they do not appear to balance off Peru and near the
equator. Instead, water temperature seems to be
noticeably affected by the seasonal cycle of specific and advection along the Peru coast.

This data set was also used to derive sea surface
temperature and not a surface heat flux departures frog
the mean for individual months during the 1972 El Nino.
The sagnitude and speed of the initial warming along the
eastern ocean sergio indicate changes in heat content at
least an order of segnitude greater than any departures
of not surface flux; this fact and the subsequent
palaward and weatward spreading of were water support an
eastward propagating Relvin wave. Subsequent changes
during an El Mino episode also do not seen to be
influenced appreciably by variations in surface heat
exchange. (Best fluxes, hest advection, El Nino).

J. Caophya, Fes., Green, Paper 301139

J. Coophys. Pes., Groon, Paper 3C1139

ATTS Circulation
EDDY REEGUT OF THE MORTHWEST ATLANTIC DETERMINED
FROM ROSS-1 SATELLITE ALTIWEST ATLANTIC DETERMINED
FROM ROSS-1 SATELLITE ALTIWEST DATA
B.C. Douglas (MOAA Mational Doean Sarvino, Ronkville,
No 20852), E.E. Chency and R.W. Agroam
From Ray 1975 to Outober 1978 the Geom 3 matellite
elizater made numerous repeated observations of sea
sorfans topography in the Morth Atlantic, Caribbean,
and Gulf of Maxion. By comparing mambers of about 1000
collinear pairs of altimater profiles, we have determined
successed sea height variability and eddy kinstic energy
in these comman regions. Our results agree qualitatively
with estimates made from traditional oceanographic
surveys, but significant quantitative difference estat
in certain areas, especially in the Gulf Stream between
Florida and Cape Hatterse where the altimatric results
show less variability. The reason for this appears to
de due to differences in apatial sampling. Historical
compute variability at satisfication and spatial variability.
In contrast, repeated actallite altimater bracks provide
point measurements of changes of sea height and elope,
embiling determined to temporal und spatial variability.
In contrast, repeated satellite altimater bracks provide
point measurements of changes of sea height and elope,
embiling determined ton of temporal variability altune,
a quantity more representative of eddy energy. It is
important to make this distinction between apage and
the because in regions of strong horizontal gradient
variability is magligible, altimatric and occompanyphic
results are in excellent agreement. (Attentry, Quir
Stream, satellite tachmiques, measonale variability).
J. Geophys. Res., Green, Papar 20111 J. Geophys. Ros., Green, Paper 301111

4740 Marine gaciogical processes A STUDY OF THE OPTICAL CHARACTERISTICS OF THE SUSPENDED PARTICLES IN THE BENTHIC NEPHELOID LAYER OF THE SOTTAN RISE R. W. Spinzad (Bigelow Laboratory for Ocean Sciences, McKown Point, W. Boothbay Harbor, Meine, 04575), J. R. V. Sameveld and J. C. Sitohen

Maine, 04575), J. R. V. Saneveld and J. C. Maine, 04575), J. R. V. Saneveld and J. C. Sitchen
Light transmission profiles have been used to study the optical properties of the suspended particles which are characteristic of the area of the Scotian Rise in the North Atlantic Ocean. This area is typified by very strong bottom currents and a highly variable bodform sorphology. A good correlation (r = 0.96) has been found between the suspended volume and the light beam attenuation coefficient. This correlation is consistent with the fact that the cumulative slope of the hyperbolic particle size distribution is nearly constant throughout the region (slope = 3.1 ± 0.3). Numerical analysis of the optical data in conjunction with particle size analysis yields values of the index of refraction of the suspended particles of 1.20 ± 0.07 relative to water. The conclusion drawn from these results is that the Scotian Rise benthic some is characterised by suspended particles of distributions which do not very much with altitude above bottom or over pariods of time fluctuations in activity of the region. (Op-Nise)

J. Geophys. Res., Green, Paper 3C1020

J. Geophys. Res., Green, Paper 3C1020

J. Geophys, Res., Green, Paper 201020

4790 Instruments and Techniques
Wild MERAGURHENTS FROM AN ARRAY OF OCCAMOGRAPHIC MOCRHOSS AND FROM F. S. METROR DURING JASTH 1978
R. A. Waller (Wood Role Occamographic Institution,
Woods Sole, Massachusetts, 02843), R. F. Payne,
During the Joint Air-Sea Interection (Jasis) experiment conducted in the northern Rockell Trough in the
ment conducted in the northern Rockell Trough in the
the property of 1978 consequence were deployed in an
array designed to investigate the variability of the
mean-murface wind field at adoles of from to 700 km.
The wind records together with observations taken on
board the research variable participating in Jasis have
wind velocity sension variables participating in Jasis have
wind velocity sension to the SERRY actulities. During
word of the experiment the wind field was charged
scrized by apartial scales large compared to the separstions between the budys. On averal operation
identified and it was possible to track the passage of
the front through the array Sewerer, quantitative
complicated both by a lack of date due to be changed
failures of sems investments and by alprificant diffrançages in the performance of the diverse types of
the frequence for the stray. Between finitional difficients
failures of sems investments and by alprificant diffrançages in the performance of the diverse types of
used in Jastis and Tarout comparison of phase

instruments with rare conventions sets of the seminary confirm the consisting that there is no conventions and confirmate error in the ASSIN wind measurement set from the dropp. In particular, the force seeing that Frontier on M., which was doe of the force of the first the recovery of tull longer record and this was consistent of the force of the first particular that the force of the first particular that is particularly but in the force of the force of the first particular to explain. Our lease recovery ASSIN.

1, Georbyn, Res., Green, Paper 301413

Particles and Fields-Interplanetary Space

The delay wind interactions with most and place Placia Mistration that the Total Activity (This minimal time, very state of the minimal time, very state that the time of the minimal time, very state that the time of the minimal time of the time of the minimal time of the officers, the officers of the office J. Lerephys. Res., Blug, Paper 3A0810

BEHTECTION OR DIK ROTTE MIND TOKE TE STEELFILE. SINU Sailar wind plasma

SPELECTION OF THE SOLAR MIND IONS AT THE LETTLY

SHOCK: SUREMIZATION

C. Anniferd (Space Science Department of EMPLIN,
Neutrinijk. The Notherlands), G. Morse of C. In.

The energies of the "reflected" (so have charde
the Parth's foreshock are tested, on stricticible,
Against a simple reflection model. The comprises
carrido out using plasma and magnetic Held marronou ISFE-2 during the period from November in bon20. 1977. According to this model, accased the inwind ions incident upon the Beath's shock that, for
reflected upstream, gain energy by displaces upon
to the interplanatury electric field. The sourper
in the reflection can be described as faceingly
angles between the interplanatury ampacis field, and
solar wind bulk velocity, and the local shock mar.

The local shack normal has been calculated with seawhich allows us to use the ion beas observation as
when far from the abook far distances up to 10-11y
the confirm, on statistical basis, the god agrees
between whenever the tractions and productions recently had
using 18 ion beam events, all observed my dos 15
Me infer that the "reflected" ion beam cannot be
the firm that the "reflected" ion beam cannot be
the firm that the "reflected" ion beam cannot be
the firm that the "reflected" ion beam cannot be
ISFE, Furestneth).

J. Gouphys. Res., Blue, Paper JA1033

5399 General (Upstress tone)
UPSTREAM OFFUPILABE SUNCHED TONE: A ACCUSED BY
CREATION AT THE DOW SMOCK AND THE GRAVES OF VILLY
SPACE STRUCTUPE THROUGH GYROPHASE HISTOR
C. OUTGINIO (Southwase Research Institut, P.A.DAY
28510, San Antonio, Tevas 78284), G. K. Paris Ci
B. H. Many.

An one of the control of the second of the s in their model, a portion of the incident persist valunity is converted into reflected properties well-with, the reflected properties are graphed to be under the growth of valuelty space structure in the graphed blackhold distribution through gropping single in application. The attracture is found to be stalled to report in diffuse and dispersed los exists the tojether with the close correlation of the charming graphed bunches with the close correlation of the charming for the charming the control of the charming the J. Georphys. Rem., Miss, Paper 3A1036

Particles and Fields— Ionosphere

TOROSPHETE

7310 Auroral mona magnetic offeats
TRIEGRAING OF EXPANSIVE PHASE INTERSIFICATION IN
MAGNETOSPHERIC RUBETORIS BY MORIMAND TRIBUSES OF
INTERPLAINTANY MOMERTIC PIELD
Gurdon Boatcher (Institute of Earth and Phostar)
Physics and Department of Physics, University of
Alberta, Education, Alberta, Canada Ted 201
Over the past devade ovidence has after sejantic
that northward turnings of the interplantary significated at the control of major substorm apparity plan
to did after in interval of suscained southerd 03 at 17 May the unnet of major substorm apparity plan
of focts. However, there has been seen question in
trian to just how many substorms are irtigated at
whether, indeed, the corrolation of substorm and
interthward turnings was just a matter of these. In
teracture appeared during disturbed period when it
it to deal functuating significantly on a line suit of
least than one hour and many substorm aspants plan
intoneif funtions were observable in the line funwas respected. The purpose of this paper is per
was respected. The purpose of this paper is to
there doer-cut examples of isolated substorm whet
the reader may be able to convince binself of the
validity of the reported triggering effect. Or the
validity of the reported triggering effect, for the
value of the THF in externally triggering of the inover the control of the control of the properior of the there is externally triggering of the insecurior process will be discussed.

J. Geophys. Ras., slue, Faper JA1021

A QUANTITATIVE DESCRIPTION OF THE SPATUA NUMBER AND DYNAMICS OF THE EMERTY FLUX IN THE CONTROLS OF A AND DYNAMICS OF THE EMERTY FLUX IN THE CONTROLS OF AFB. HA 01731).

Energy flux in the continuous (or diffus) apply found to be constant instantaneously along conficulties of apply of the constant instantaneously along conficulties.

found to be comeant instantaneously also serve which are defined analytically as a function of merital end ur. Coordinates which are defined analytically as a function of instantaneously and in the user circles in magnetic latitude-magnetic fool in serve at a pole offset from the magnetic local in serve quence, the latitudinal distribution in these quencies the latitudinal distribution in these quency (the observand extent of which is 10.17) pages of the poles in the distribution do 30 including the country of the country of

take place in the distribution do so symmetric place in the distribution through the extent.

These properties are observed in a case soft and hours duration by an array of ground and all and hours duration by an array of ground and all and incomplete sounders which span the 18 hours will be continuous auroral latitudes. Exercit the continuous aurora is derived from the continuous aurora is desired from the continuous aurora distribution and the continuous aurora places and filter for the continuous aurora places and the continuous aurora places and the continuous aurora places aurora distribution is found in all 32 settembre full-width-at-half-maxicus, Accordingly be desired found the action of the continuous aurora auro J. Gamphys. Res., Blue, Paper 340980

590 Electric fields CYDONE FOR THE Ex B DRIFT OF PULSATING AURORAS R.W.J. Scourfield (Physics Department, University of Rutl, Durban 4001, South Africa), J.G. Keys, E. Nielsen, Ratl, Durban 4001, South Africa)

N.A.J. Scortfell triysters, and a second trible tributed for the second tribut

Crophys. Res., slue, Paper 3A1102

1530 High-latitude Tomospieric Currents
HIATHE CONTERBUTION OF LONGSFIERIC COMBUCTIVITY
HIGH RECERT FIELD TO THE AURORAL ELECTROJETS
I. Emide (NOAR Space Environment Laboratory,
Healds: Colorade 80303) and J. F. Vickrey
Bate from continuous scans of the Chatanian
rader beam slong the magnetic mortidian plane are
stillized to determine the latitudinal profile of
hight-integrated ionospharic conductivities and
britostal sleetric fields, from which the latirollinal distribution of ionospheric currents is
debtede. The observations cover inveriant latitodes between 52° and 58°, where the IMS Alaska
serialan chain of magnetomators uses also in operstion. Allowals has conductivities and the
electric fields are interrelated, the relative
importance of the two in driving the eastward and settend auroral electrojet currents can be assessed. It is found that for underste and large current densities (i.a., 2 0.2 A/m), the porthward carear densities (i.e., > 0.2 A/m), the northward electric field acreage increases as the sugnitude of the assertard electrojet in the avening sector increases. The height-integrated Hall conductivity stays generally at the level of 10 mine even these the current density becomes as large as 1 A/m. However, when the esseward electrojet is mail, substantial electric field of 10-20 mVm my still exist as if the magnetosphera has a presistant colouge source. There appear to be used in the components to the westward electrojet. In the addight and early norming sectors (1000 MLT) intensity is characterized by a weak touthward electric field and a high Hall conductivity, whereas its late morning portion (10100 MLT) is desirated by a strong southward electric field.

J. Geophys. Res., Blue, Paper 3A1104

had leteror than between ways and particles but figure than between waves and particles (SARCHER) the FLOWING CONSTANT SARCHERS (FLOWING PRESCRIPTION FOR THE ACCIDENT FOR THE ACCIDENT SARCHERS (COMPRESCRIPTION FOR THE ACCIDENT SARCHERS (COM IMBGLTR FLECTION PRECIPITATION DUE TO GARORESONANT

Control Res. Blue, Paper 4 VOSA7

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to as the least the content of the process of the targe positive is content on the process of the targe positive is content on the process of the targe positive is content on the process of the target positive is a small mount of gramment (fill interconnect with the northwest tas as a source of concern, due grismarily to content the process of the target positive is the northwest task of the positive positive process of the target positive in the positive positive process of the target posit Tossi when the region of fast convective flow moves plawed following the substorm. These extended E-W truth by corotation. Relative to the surrounding a destroyed only when it is carried into sunlight on the damp side.

(ionosphere currents a convection of fluctuations).

(ionosphere currents a convection of currents and currents and convection of currents and currents and convection of currents and convection of currents and a unitroyed only when the dayn side.

J. Geophys. Ban., Blum, Paper JA1046

1343 Ionospharic discurbances
13419315 AND NUMERICAL SINGLATION OF THE EFFECT OF ION
PUREER MOSILITY ON IONOSPHEMIC BARTUM CLOUDS\*

[A]. Lalent (Code 4780, Fleras Physics Division,
[A]. Fedder and S.L. Ossakow

We analyze the effect of finite ton Federann
ability On the evolution of ionospheric berium We analyze the effect of finite ion Federaen mobility on the evolution of ionospharic berium clouds, the avolution of ionospharic berium clouds, the avolution of ionospharic berium can lask out of the assign of density/federaen conductivity and hence loss the alivated assautic-field-line integrated electron delity to attention that the finite Federaen mobility of the attentions allows these to separate from the alcude berium loss allows these to separate from the alcude with have virtually no Federaen conductivity. The berium is replaned in the electron violate to the these to separate from the alcude with have virtually no Federaen constituting the ambient lonosphere, their own Federaen mobility. (Here we take the charter own Federaen mobility. (Here we take the school of the constituting the ambient lonosphere, cloud to be that defined by regions of deasity, not by local electron density enhance—the harten is expanded and hence attains a density should for the process of entiting the electron cloud, lower than expanded and hence attains a density should for the process of entiting the electron cloud, lower than a composited with the electron vill here they completely with the electron cloud, for the process of entiting the electron berium in affect left the region of further electron cloud, it can form a long thin sheet of lower density cloud, it can form a long thin sheet of lower density which is considerably attempt then the attents.

structuring) edge of the cloud. An observer watching only the barium or only <u>local</u> electron densities would conclude that the structuring process had commed. Further, the electron cloud treals may decay if the inner coording with it are subject to a fast recombination chamistry. (Barium clouds, ion clouds, strictions, Padersen Robility).

Work supported by the Defense Nuclear Agency J. Geoghym. Res., Blue, Paper 140922

1345 Ignoupheric Disturbances
THEORIES OF HIGH LATITUPE INDOSPRENCE IRREGULARITIES;
A REVIEW A REVIEW
M.J. Fashinen (Naval Research Laboratory, Washington,
D.C. 20375) and S.L. Ossakov
A review of theories of naturally occurring high
latitude ionospheric irregularities, etructures, and
striations is presented. Both E and F regularity
sources
suchanisms exphasized. Becant theoretical results are
streaged and outlanding problems identified.
Rec. 3CL., Espect 20032

3550 Airgiow DEPENDENCE OF AURORAL FUV EMISSIONS ON THE INCIDENT ELECTRON SPECTRUM AND MEUTRAL AIMOSPHEE D.J. Strickland (Beers Associates, Inc., Post Office Box 2549, Reston, Virginia 22090), J.R. Jasperse and J.A. Whalen.

No. 2549, Realon, Virginia 2209D), J.R. Jasperse and J.A. Whalen.

In this paper we examine the relationship among certain prominent auroral FDV emission features, the incident electron spectrus, and the model neutral attosphere. Given the neutral attosphere we show that for sipple models of the incident electron spectrum (Naxwellism and Gaussian in energy) extellise measurements of FDV emission features, in parinciple, determine the incident electron spectrum. We also discuss the telationship between the incident electron spectrum and the E-region plasma density profile for the continuous (diffuse) surora and for a scale arc. (FUV emissions, aurora, electron transport).

J. Geophya. Ros., Blue, Paper 340370

5550 Low - latitude tonospheric currents
A THEORETICAL HODEL OF FOUNTWIAL F-REGION DYNAMICS
S. Duhau (Departemento de Ffelca, Universidad de Bueuco
Alrea, Feaultad de Cleoties Leactes y Naturales, Citodal
Universitaria, 1428, Buence Aires, Argentina), and A.

Universitaria, 1428, Buanca Airea, Argantina), and A. Louro

A simple dynamical model of the equatorial F-region is presented, in which this section of the fomesphere is coupled to the E-region, which is represented by a thin horizontal current layer, and the eartical current density at the base of the F-region is taken to be composed entirely of current normal to the geomagnotic field lines, according to a previous finding by the surhors. The new boundary condition for the current lensity at the interphase between the E- and F- layers implifies the system of equations. The model is applied to calculate the xosal for whocky and the wartical current at the boundary between the F- and F- regions.

1. Geophys. Res., Blus, Paper 140059

550 Low - latitude Loncapheric currents
NE CURRENT FLOW BETWERN THE EQUATORIAL E AND P REGIOUS
. Duhau Oppartamento de Pfaica, Universidad de Buonos
ireas, Facultad de Ciencias Exactas y Naturales, Cluded
hiversiteria, 1428, Buenos Aires, Argentine), and A.

hiversiteria, 1428, Bueson Airss, Argentine), and a-ouro. In dynamical calculations in the equatorial F-region it is usually assumed that the current flowing through the base of the F-region does so exclusively along the geomegnetic field lines. This hypothesis is revised in the present paper and it is found that the regior contribution to the total flow at that beight is given by the current normal to the field lines. J. Geophys. Pus., Blue, Paper 3A0658

J. Geophya, Pus., Blue, Paper 3A0558

5300 Particle precipitation
AURORAL RLECTROS BOUNDARIES AND IMP B.
X. Makita\* (Applied Physics Laboratory, The Johns
Hopkins University, Learel, Maryland, 20/07), C.-1.
Meny and S.-I. Akasofu

On the basis of the sureral pracipitating electron
data, slong the dawn-dust ceridian, from a Defense
Mateorological Sacilite Program satellite (DNGF-F2),
we show that the electron pracipitation region extends
poleward, often to the geomagnetic letitudes - 85°
from the average ovel location, during quiet periods
(namely, during periods of a large positive B, composent). This result may be interpreted as an indication that only a small smount of geometric flux
interconnects with the northward IMF, resulting in a
contracted 'open' region (the polar cap). The control
of the location of the polaward boundary by the northsouth component of the 1MF is also statistically
examined. The rate of latitudinal movement is about
0.4° to 0.8° per 1 mT for positive IMF B, values and
about 0.7° to 1.1° per 1 nT for negative IMF B,
values. The shift of the equatorward boundary is,
however, not obvious for positive IMF B, values. As
geomagnetic activity increases, both the poleward and
equatorward boundaries shift towards lower latitudes. The shift of the equatorward boundary, resulting in a thinner electron precipitation region
during disturbed periods that during quiet periods.

\*\*On leave from Takashoku University, Bunkyoku,

5580 Hews Propagation

HF RAYHACING AT HICK LATITUDES USING MEASURED

HERDIGENAL ELECTRON DENSITY DISTRIBUTIONS

J. P. Villain (Laboratolra de Sondague Elsotromagnétiques de l'Euriconnegent Terrentre, Université de

Toulon, Bid des Armarin, 63100 Toulon, France), R. A.

Urugnesid and J. F. Vickrey

In many physical cases, well and interagilate coulé

(1-100e) elsotron density irregularities in the

tonospherio E myd F-region are elongated in the

direction of the Earth's amonetic field, As a spenit

of this elongation or field-alliquents, radar atudies

directed toward the analysis of backsnottered mignals

from lonospherio irregularities require that the radar

pages—toutor propagate perpendicular to the magnetic

field in the irregularity region; at loy and middle

latitudes orthogonality may be achieved at any radar

operating frequency, but at higher is itudes this quonantly becames increasingly difficult. Amons 60% invariant latitude it is sincet impossible to exhicut margality with straight line propagation. In under to observe the wealth of iomospheric irrequiarties in the surgest constant as if frequencies where refraction affacts wave propagation and side one in achieving the orthogonality condition, However refraction from large scale (1-100m) iomospheric irrequiarily otherwise also increases the respiculty in recurring the orthogonality condition, the scattering volume, in this paper we use a modified version of an existing if ray traing program to determine with high precision the hif propagation paths in a realistic iomosphere, in this analysts the iomosphere to minusional array of electron density as a function of the manipular and version of the Chatonias incoherent acuter rader and we show how the electron density at a function of startifution afforts propagation from a meridian scan of the Chatonias incoherent acuter rader and we show how the electron density distribution afforts propagation from a meridian scan of the Chatonias incoherent acuter rader and we show how the electron density distribution afforts propagation from a simulated if radar located at Amendrago, Alaeto, In wariotions of the propagation conditions are also studied as one sewes the density pattern in the direction of the Anchorage rader, lead, Sci., Paper 181009

5580 Wave Propagation (Louosphere)
VLF ARFLECTION PROPERTIES OF THE NORMAL AND
DISTURBED FOLAR (GOSSPHERE IN NORTHERM CPEETLAND
P. A. Yousey (Propagation Branch, Rome Air
Development Canter, Hanscom Air Porce Bass,
Hansenhussita (1711), J. P. Turtis, B.P.
Pagaliaruto, W. I. Klemetti and J. E. Rasmusson
Long wave reflection properties of the high
latitude louosphere under both quiet and highly
disturbed conditions, are dearthed. The data
wore obtained using a short-pulse VLF Conceounder
located within the polar cap, in northern
Graenland. Under quiet ionospheric conditions
ambetantiel diurnal, day-lo-day, assumal, and
solar cycle variations were observed. During
polar cap absorption aveats the VLF reflection
properties of the discurbed ionosphere depended
greatly on the solar illusivation conditions,
as well as the sugalitude of the in-coaling
onergatic particle flux. The use of the steepincidance VLF reflection data to develop and
validate models of the lover ionomphere is
discussed and, electron density profiles are
given, derived from reflection data obtained
during quiet and disturbed conditions. [Icw
froquency, D-region, absorption events).
J. Caophys. Res., Creen, Paper 100-60

5500 Mave propagation
ALOUFIE-ISTS PADIO MAVE STUDIES OF THE (LEFT, INE
AUDOPAL ZORL AND THE HAIM TROUGH AND OF THEIN ASSOCIATE.
IRREGULARITIES
D.B. Muldrew (Communications Research Centre, P.O. Ro.
11490, Station "M", fittawa, Bohario, (AMANA 77H 852)
The principal high-latitude ionospheric features such
as the cleft, the nightline auroral zone, the nain
trough and their associated irregularities, as observed
with the Alouette/ISIS topside sounders, are reviowed.
These features can be clearly distinguished in
Alouette-I electron density contour plots as a function
of latitude and height below 1000 km. Alouette 2 data
recorded near apogee (1000 km) show the location of that
light-lon (M" and Ne") trough as a function of local
time and show it to be more closely related to the
plasmapause than is the rain trough. An attempt is nade
to clarify the location and terminalogy of trough-libs
structures. Regions of small-scale irregularities (tens
of meters) are associated with the high-latitude
lonospheric features. These irregularities are
responsible for the presence of aspect-sensitive spread
f on logside longerams. The most intense spread is
found in the cleft region. Spread-F regions usually
have a sharp opustorward boundary. Some recent
unpublished work by the author, indicates that the
spread-F boundary for the nightline auroral zone tends
to be located several degrees equatorward of the left
and reduction and convected
equatorward. In the main trough region spread is
sometimes present and other times absent, Some of the
individual shall-scale irregularities responsible for
spread f can extend along magnetic-field lines for
hundreds of kilometers. (Cleft, auroral zone, mein
trough, irregularities.) Department of Geology 206-676-3595

May 17.

pinally, theoretical estimates based on a new principly, theoretical estimates approximate of the solion of a particle indicate that accounting for small concentrations of H resorts that one of the same calculated and measured currents on the webs-mids of the ALC satellite. (Charging, electric field, particle measu ). Goophys. Res., Blue, Paper 3A1031

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30th Pacific Northwest Regional Meeting

September 30-October 1, 1983

Western Washington University Bellingham, Washington

Convenors: Myrl E. Beck, Jr. and David C. Engebretson

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David E. Engebretson PNAGU

Western Washington University Bellingham, WA 98225

For registration information or to mail abstracts, contact

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Call previously published in EOS

The downstream waves are predominantly the right-hand polarized feat magnetosonic waves (u < 0, ). (1) The transition from the laminar faubtritical in the tarbulant (supercritical) about attractures is shown to result from the firshese instability which occurs when Val > 3. (iv) The dissipation mechanism for the quasiparallel shock in our simulation is identified with the nonadiabatic compression of loss streaming through the low frequency whistler weres (u < 0,), resulting in conversion of ion streaming energy to ion thermal energy. (v) Significant for head flux flowing upstream occurs when Nai 2 3, is due primarily to the backscattering of highly manadiabatically heated ions.). Coophess Ress. Sinc. Paper 140078

5715 Electric Fields
A STATISTICAL STUDY OF LARGE ELECTRIC FIELD EVENTS IN
THE EARTH'S MAGNETOTAIL
S. Lavb: (Physics Department and Space Sciences Laborators, University
of California, Benkeley, California, 94720), X. Whiley, and F. S. Mozer
A matuacid study of large electric field events, measured on ISEE-1
at geocentric distances of 3 to 23 Mg, has been performed in order to
determine the occurrance frequency sod spellal distribution of such
events. Large electric fields were seen at all abundas, with the lowest stuinde events occurring on autoral field lines and the higher altitude events
events had amplitudes that were approximately proportional to the Square
root of the local magnetic field strength, in agreement with expectations of a
simple mapping model. The apparant concentration of bag field events
near local midnight is caused, at least in part, by a nonundorm frequency
of satellite costings is through the plasmasheer boundary as a function of
local time. Thus, the spatial distribution and amplitudes of the large field
events are not inconstront with the mapping of low-stitude electrostatic
shocks to the plasmashees boundary and magnetic field
lines.

1. Geophys. Rus., Blue, Paper 3A1046

5720 Interpotions between solar wind and magnetosphere RADIO EXISSION SIGNATURE OF SATURE INMESSIONS IN JUPITER'S MAGNETIC TAIL.
N. D. Deach (#458/Goddard Space Flight Center, Laboratory for Extratorrestrial Physics, Greenbelt, MD, 20771)

MD, 20771)
During the interval from about May through August
1981, when Voyager 2 was Inbound to Saturn, the
Flanetary Radio Jatronomy instrument measured
repeated, dramatic decreases in the intersity of the
Saturn Kilometric Radiation (SKR), The emission rotations in duration. Comparison with pre-Saturn encounter Voyager I chasrwattens (dure to Movember, 1980) shows that the SKK dropouts were unique to the Voyager 2 observing interval, constated with the closer profisity of Saturn to Jupiter's distint magnetabil in 1985. Further, the dropouts occurred on the everage at times when Voyager 2 is known to have been within or mear Jupiter's aggnetic tail. Interpretation of these events as the radio signatures of successive Saturn insersions into Jupiter's tail or water region is consistent with the independent evidence that the SKR radio source is driven externally by the solar wind ray pressure. The dropouts are identical to the one observed just after yoyager 2 closest approach to Saturn, providing the best evidence that Saturn was within Jupiter's tail at the time of the succession. The sequence of events suring this Saturn tail encounter is deduced, (Saturn, Josiam magnetabili, Yoyager, radio, astronomy, solar wind).

J. Caophys: Rea., Slue, Paper MA1000

J. Gaophys: Res., Blue, Paper 3A1000

572D Teteractions between agler wind and magnetoaphure THE BELATIONSHIP RETHERS SATURN KILOMETRIC BADIATION AND THE SOLIS WIND N. D. Desch (Goddard Space Plight Center, Laboratory for Extraterractical Physics, Greenbell, ND, 2077)), N. O. Ruster

H. O. Eucker
Yoyager spacecraft radio, interplanetary plasms, and
interplanetary disposite field data are used to show
that large amplitude fluctuations in the power
generated by the Saturn kiloseptic radio beission are
best correlated with solar wind ram pressure
vertations. In all, thirteen solar wind questitlespreviously found important is driving lerrantial segmetospherid substyrms and other auroral processes were exemised for evidence of correlations with the Saturn rivio emission. The results are contistent with hydromegastid ways or sady diffusion processes driven by large scale solar wind pressure charges at Saturn's dayside segmetapause. (Saturn, Yoyager, radio

5736 Magnetic tell

5736 Magnetic tell

EVYLLOPMENT OF SUBSTORM ACTIVITY IN MELTIPLE-CASET

SUBSTORMS AT STMERMOROUS ORBIT

T. Magei (Space Science Laboratory, MASA/Marahall

Space Flight Center, Manlaville, AL 35812),

D. M., Baker and F. R. Highle

The development of substorm activity at synchronous orbit (6.4 M.) for multiple-onset substorms was attained by using the energetic particle and segnatio orbit (6.4 M.) for multiple-onset substorms was attained by using the energetic particle and segnatio orbit (6.4 M.) for multiple-onset substorms was attained by using the energetic particle and segnatio orbit of 6.4 M.) for multiple-onset substorms at three local time groups of 30- to 2000-keV region). The geostationary apaceraft 1976-059 and 1977-007 provided the measurements of 30- to 2000-keV cleatrons, and 0053 is and 0053 and 1977-007 provided the measurements, and 0053 is and 0053 the measurements of the segnation of 154 he ground segnation verticions in a wide area were examined to determine the general characteristics of substorm activity and the things of various phenomens. The substorm evolutions showed a variety of forms at synchronous orbit but they can be characterized by the following views Substorm activity initially starts in a longitudically listed sector which is activity then expands weathers and eastward during a period of successive omests. There is an indication that the weathered propagation is faiter than the eastward propagation. (Substorms, particle measurements, pageel.) of fails, symphonous orbits. pagnetic field, symphronous orbit) J. Ceaphys. Res. Sive, Paper 141022

5736 Magnetic Isil (Energetic Particles)
EMERGETIC PARTICLES IN THE VICINITY OF A POSSIBLE
MEUTRAL LINE IN THE PLASMA SMEET
E. Mobius (Max-Planck-Institut für Physik und Astrophysik, Institut für extraterrestrische Physik,
BD56 Garching, f.R.G.), M. Scholer, D. Hovestadt,
G. Pascheann, and G. Glockiar
We have analyzed energetic grotons in the government

Bible Garching, F.R.G. J. N. Scholer, O. Hovestadt,
G. Paschrahm, and G. Gioschir
We have analyzed energetic protons in the energy range
No 10 to 500 keV and energetic protons in the energy range
No 15E-1 during a plasma sheet crossing on March 26,
1978. The behaviour of protons with energies of more
than - 16G keV is vary different from that of the
- 30 to - 100 keV protons which represent the suprathercul tail of the plasma sheet distrib. (on. The more
amergetic forms appear on the time scale of several minutifield. At about the same time the plasma measurements
field At about the same time the plasma measurements
field, and plasma observations and the proton and elacfield, and plasma observations and the proton and elacfield and move earthward further cours well within
the plasma sheet. In this framework the magnetic mattral
line extent of the neutral line would be limited to the
dush side of the tail. No disruption of the plasma theet
(Chergetic particles, neutral line, plasma sheet).

3739 Magnetopanes

Internation in Jupiter's and MP crossings of the tail stant amanetic
that difficult assessable that the tail official to difficult and the tail official to difficult and the caporat to
the summand mapped assessable that fact, together the that the tail proton that the fact, together that the tail trifficult of
the first that of the plasma there
that of the plasma description of the sure and the summand magnetor falls and the tail that of the tail in the follower of the mergetic particles.

Saturn may have been related to the position of the Pollower of the trifficult of the tail that the description of the plasma t

STIP Hagnatopasse
IMPRECTION OF RIMI CURRENT IONS WITH THE MAGNETOPAUSE
M. Echoler (Max-Planck-Institut für Physik und Astrophysik, Institut für outraterrastrische Physik,
Solf Garching, FROJ and F. M. Ipsvich
We have analyzed phase space density observations of
cling current protoes (30 - 130 keV) during a magnatopaule crossing of IEEE i on July 5, 1978. Planca and
Edgnatic field data obtained during this crossing have
been reported to be consistent with quasi-steady reconnaction and a reconnection line south of the satellita

Why and where shocks form in

Shock dynamics and evolution.

activity, planetary bow shocks,

corotation shocks, and shock-

Shocks associated with solar

the heliosphere?

shock interactions.

5732 Magnetic Sterms
LONGTUDBAGE FUNCTURE OF SURSTORN INTECTIONS AT
BYCHEROLOG CREAT

1. A. Armidy (Space Actors, intronsity of NorFORM Subject of Comments of the Comments of the Synchronous orbit and finite in of a substrons of the synchronous orbit and spants field reconfiguration to the synchronous orbit is about three bours of selectoric factors field in the synchronous orbit.

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For Lon-to-nedurate posturers were transposted to the state of selectoric factors field in the synchronous orbit.

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J. Geophys. Res., Blue, Paper JA0797

J. Geophys. Res., Blus, Paper JA0797

bits Hagnatospheric configuration
STRUCTURE AND DYNAMICS OF SATURN'S OUTER MAGNETOSPHERE
AND BOUNDARY MEDIONS

E. M. Beharmon (MASA/Goddard Space Flight Center,
Laboratory for Fitraterrestrial Physics, Gresbelt,
Maryland 20771), R. P. Lepping and M. F. Mess

In 1979-1981, the three USA spacecraft Flonesr II and
Voyagers I and 2 discovered and apployed the magnetosphere of Saturn to the limited extent possible on flyby
trajectories. Considerable variation in the locations
of the bow shook (ES) and amagnetopeaus (HP) surfaces
uses observed in association with variable solar wind
conditions and, during the Voyager 2 encounter, possible
immersion in Jupiter's distant amagnetic tail. The
limited number of ES and MP prossings were concentrated
near the subscier region and the dawn trainator, and
that fact, together with the temporal variability, makes
it difficult to assess the three-dimensional phape of
the sunward magnetospheric boundary. The rocalined ES
and MP recasing positions from the three spacecraft
yield an average 65-to-MP stagnation point distance
ratio of 1.29 y 0.10. This is many the 1.33 walus for
the carth's magnetosphere, implying a similar sunward
shape at Saturn. Study of the structure and dynamical
behavior of the outer magnetosphere, both in the sunward
behavior of the outer magnetosphere, both in the sunward
behavior of the outer magnetosphere found by Voyager 1 for
tallward flowing plasma mear the pre-deem MP, a
phacomeon well known for the cases of both Earth and
Jupiter. Has one similar to that of Earth and
Jupiter. That bils was not observed by Voyager 1 for
tallward flowing plasma mear the pre-deem MP, a
phacomeon well known for the cases of both Earth and
Jupiter. That bils was not observed by Voyager 2 at
Asturn may have been related to the possible immersion
of Saturn in Jupiter's magnetosphere, industry layer).

J. Geophys. Res., Blue, Paper Jallon

5755 (Pissus Instabilities)
SIMULATION OF THE ION TEARING INSTABILITY IN THE
PRESENCE OF A RACKONOUND PLASMA
J.J. Ambrosiano, L.C. Les (Geophysical Institute,
University of Alesks, Pairbanks, Aleska, 99701) and
D.W. Swift

D.W. Swift
A tooparises is made between two classes of Vissov
equilibris with respect to the ion tearing mode
equilibris. The first class is that of a current
sheat in equilibrium with a vacuum (Herris typs). The
smood class is that of a current sheat in equilibrium
with a sagnetism background plasma. The comparison is
made via a simple megactofuncture simulation involving

Subcritical, supercritical, quasi-

· Dissipation mechanisms.

shocks.

The foreshock.

parallel, and quasi-perpendicular

Particle acceleration mechanisms.

Chapman Conference

on Collisionless Shock Waves

in the Heliosphere

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Convenor: R. G. Stone

Abstract Deadline: November 1, 1983

Invited reviews and contributed papers in the following general areas: Overview of the collisionless shock, macroscopic aspects of shocks, microscopic aspects of

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Call for papers published in EOS, May 31, 1983

shocks and particle acceleration. Typical subjects to be covered include:

ions alone. We find that the presence of the background spacies has several dressite affects: The linear growth retes are affected; the tearing mode can be acabilised or destabilised by the background plasse; and the anchange of energy between particles and fields is affected. In particular, the saturation wave energy level of the tearing instability can be either enhanced or reduced by a factor of 10 from the Marris type depending on the depth of the penatration of the background particles into the neutral sheet.

J. Geophys. Res., Blue, Paper 3A1044

hackground particles into the neutral sheet.

J. Geophys. Res., Blue, Paper JA1044

5755 Patticles and Fields (Flasse instabilities)

SIMULATIONS OF BEAM EXCITED MINOR SPECIES GYROMARRANICS
IN THE PORCUPINE EXPERIMENT

I. Rock (Space Sciences Lab, University of California, Barkeley, California, 94720), C. W. Carlson, M. K.

Hudson and R. L. Lysak

The Forcupine acounding rocket experiment included a spinulag doughter payload squipped with a kenon plannagus that emitted an ion beam nearly transverse to the cagnetic field. Wave instruments on the unin payload datecod electrostatic waves at hydrogon gyroharomics and at the lower hybrid frequency within the beam. We have performed a series of computer simulations to investigate the behavior of a system including a Monumbeam, socialed from the rocket superiment, and a barkground incomphere plasses of oxygen plus a small concentration of bydrogen. In those one-dimensional eleminations, a spatially homogeneous menon been is injected perpendicular to the superior field and at various angless with respect to the wave propagation vectors. Waves are excited over a range of those angles with a maximum growth near O<sup>5</sup>, when the Menon beam is in the wave propagation direction. Despite the maxim hydrogen concentration (~1X), the wave spuctral analysis shows marrow peaks must the hydrogen gyrofrequencies at low beam densities, which disappeer at high beam densities when the spectrum is dominated by the lower hybrid peak. A similar transition in the spectrum was seen on the tocket flight due to beam spreading with increasing distance from the somon gun. Theoretical interpretation is given in terms of a transition from a resonant inability at low beam densities.

J. Gaophys. Res., Blue, Paper JA1024

5760 Plasma motion, gonvection, or circulation

J. Gaophys. Res., Blue, Paper JA024

5760 Plasma motion, convection, or circulation LCM\_EMERGY (< 100 eV) FON PITCH ANGLE DISTRIBUTIONS IN THE MAGNETOSPHERE BY ISEE 1

T. Magaf (Spece Science Laboratory, MASA/Marchall Space Flight Center, Runtwille, AL 35812), J.F.Z. Johnson, and C. R. Chappell

Low-energy (< 100 eV) ion data from the plasma composition expariment on ISEE 1 are examined statistically to study pitch angle distributions in all local times of the magnetosphere (L x ]-10). The pitch angle distributions in the data set used here can be classified into seven types, however, there are four major types, i.e., isotropic distribution, and low flux. The isotropic distribution, and low flux in the isotropic distribution, and low flux. The isotropic distribution which consists of very low energy (typically < 10 eV) ions is a persistent feature in the inner region, It is requestly observed with an accompanying loss conselles atructure. The bi-directional field-aligned distribution consisting of varma ions (> 10 aV) is a persistent feature on the outer dayside and it is seen just outside the lastropic distribution region of the nightside. It is noted that the loss conselles atructure is also a common feature of this type of distribution in the noon seator. On the outer nightside the unidirectionsi field-aligned distribution in the noon seator. On the outer nightside the unidirectionsi field-aligned distribution consisting of varm ions is the dominant alignature, but in some censes only the low flux (no expressible of these reautes and others. (particle measurements, convection).

J. Goophys. Pea., Blue, Paper 140947

5770 Short-period (lose than I day) variations of THE LOCALIZATION OF P12 PULSATIONS: GROUND-SATELLITE
OBSERVATIONS

J. Goophys. Res., Blue, Paper 3AD947

agnetic field
THE LOCALITATION OF P12 PULSATIONS: CRUUND-SATALLITE
OBSERVATIONS
H.J. Singer (Air Force Geophysics Laburatory/PHG.
Baseom AFS, HA 01731), W.J. Bughes, P.F. Fougere,
D.J. Enecht.

Much of the attention given to P1 2 pulsations has
resulted from their close relationship with substant
onests. Most of the observations have been from
ground-based observations, with few observations in
spaces. Consequently, there are problems in determining the axion of the pulsation region in thu
magnetosphere and in clarifying the substant process
from information contained in the P1 2 signal. To
further our understanding of P1 2's and substance,
signal and substance,
signal and substance,
signal and substance,
using GOES 2 and 3 satellites, are presented, the
observations indicate that the P1 2 signal in space
is often localized such that synchronous satellites
superstant one indicate that the P1 2 signal in space
is often localized such that synchronous satellites
superstant to this, on the ground at mid-intitudes,
aisilar features are often observed across the 50°
width of the AFC Hagnetorator Naturak. In addition,
when P1 2's occur, se indicated by ground observations,
that observation at synchronous orbit near midnight
is more likely during times of large rather than
small Kps. These results are interpreted in terre of
the plasma-shaet motole which he proviously beau
used to axplain nom of the observed properties of
P1 2 pulsations. (asynotic pulsations, F12, Substance)
J. Geophys. Res., Blue, Paper JA0948

5770 (Short-pariod variations of magnetic field)
POLARIZATION PATTERNS OF P1 2 MAGNETIC FULSATIONS AND
THE SUSTOMA CURRENT WEDGE
N. Lester (Department of Astronomy, Roston Univorsity,
Boston, MA 6213), W.J. Rughes and B.J. Singer
The results of an enalysis of 16 F1 2 pulsations
otherwed with an extended mast-west chain of midletitude ground-based magnetometers are reported. The
events were chosen such that the center of the substorm
current system, defined using the midletitude beye
associated with these pulsations, was within the
longitudinal extent of the station chain. A current
wedge social is also used to interprat the observed
polarisation pattern of the F1 2 pulsations. This
pattern is used to locate the center of the F1 2
current system. The centers of the F1 2 and substorm
current system. The centers of the F1 2 and substorm
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current system. The centers of the F1 2 and substorm
current system. The centers of the F1 2 and substorm
current system. The centers of the F1 2 and substorm
current system and the substorm current wedge
are not always the same. The longitudinal extent of
the system section to the F1 2
polarization pattern averages "500 or "5 hours local
time for the sweats in the study. The sense of
allipticity of the waves agrees with previous results
from these latitudes, i.e. mit-closkwise locking
down the field line in the Northern Hessisphere.

Salantas of the wave phase difference between stations above that, in general, the eastern attains of a station pair leads the western due at all local times for both H and D components. When plotted in a sobsture coordinate system, based on the middaticude bay, the phase difference per degree of localised above a tendency to decrease in the seatern portion of the current wedge. This longitudinal pattern of phase difference is constituted with the eastern, downerd, field-aligned current being less localised than the western, upward, field-aligned currents.

J. Goophys. Bos. Bus. Page 21001 J. Geophys. Hes., blue, Paper 3Al061

5765 Whistlers

A THEORETICAL STUDY OF PLASMASPERIOR SIGN GERRATION

C. Y. Shang (Dept. of Physics and Astronomy, University
of Lows, Lova City, Lows 52222), C. K. Gourts and R. R.
Anderson

An investigation of the generation of plasmapheric
hiss by the whistler-mode instability has been carried
out. Using combined ray-tracing and growth-rate calcumasher of waves have been calculated using a discribetion function of the form F = g-e sin a. In general
tion function of the form F = g-e sin a. In general
traced, or noon after. This is true of all the waves
traced, independent of the distribution functions used
for the warrystic (resonant) slattrone. Thus the growth
rates are generally low, since the waves undergo rev
squatorial transite. A pomperium of these reunits with
observed spectra indicates that while some spectral
coherent interpretation are in qualitative agreement, there is a
spheric hies, instabilities; wave observations).

560 Missellaneous (Upstream Partition)

over the interching conductivity via 5 over the interching conductivity via 5 over the interching bonds modes. We have able in the change of the bulk sound speed, or the Debre at from the bulk sound speed, or the Debre at from the forestory. If the SARTH'S SOW SHOCK.

UPSTARAM OF THE SARTH'S SOW SHOCK.

M. F. Thornier (MS D433; Lee Alemes Nettenat Laboratory. The specifies predicted by four different; about a bulk sound speed agrees hour before with studying set of the change of the specifies predicted by four different; about a hypothesis of the compromised from the best thought.

With the statement of the specifies bedwitch the bulk sound speed agrees hour below with studying sound speed agrees hour below with sound speed of the hugh sound speed of the hugh sound speed agrees hour below with sound speed agrees hour below with sound speed of the sound spe

Are compaind with unsarvations of upstream historia heams and "Byrating loan" events. A kinemit term in a frame of reference in which the molivel eart of the incident solar wind is found to be the matrix of the incident solar wind is found to be the matrix of the incident solar wind is found to be the matrix of the incident solar wind in found to be the matrix of the incident solar winds in the solar case of the recent hypothesis that field-aligned band in a case of the recent hypothesis that field-aligned band in a case of the solar properties of the shock provides good segment to cover of the shock provides good segment to observed energies of many field-aligned band solar every source of the shock for which solar wind in a solar end in the magnetic moment of an ion though the magnetic moment of an ion though the transport of the country of the shock is sufficiently reflected at the shock in profess some specularly reflected at the shock on the specularly reflected at the shock on the shock of t

J. Gcuphys. Rus., Rino, Paper Jai049

5799 General (Low-Energy Plasma)
CHARACTERISTICS OF LCW-ENERGY Plasma in the Plasma Property of the Characteristics of LCW-ENERGY Plasma in the Plasma Property of the Canter, E553, Auntoville, Al. 35612), C. I. Guput Date from the Light Ion Meas Spectroster (E5s the SCATHA astellite is used to stoy the low-mer (< 100 eV) plasma populations at a near-gospency orbit. The observation of the plasma is uncon-to-midnight acator during quiet to address populations tended to group into three diminity populations tended to group into three diminity at these were a warm trapped distribution, away as distribution with it eV. The cold plasma was seen after 1800 if only periods of magnetic quiet and was charred to plasma is identified as encounters with the plasma tough. The praemos of these wars glasma populations may be responsible for the different than stone and the surface of the surgained from whistler measurements made on COD 5 (Chappell at 1970). The effects of the spaneers of plasma is the low-energy plasma geasurements is stadied, ithreshold effect may be operative whereby whe to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to cold plasma dennity decreases to less than shot i iona/on; the approacher prestive shortely was to c

### Physical Properties of Rock

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Since craphyse. Ren., Red, Paper 180700

6110 Kinstistry, Fracture, and flow
SERIER Craphyses of PINGLE-CRYSTAL PRESENT
J. Pater Matt (Peparthemt of Galocy, Semanter
technic Institute, Froy, W. 12181) and Thomas J. Ec.
Dynamic compression results are reported for six
crystal forstarite shocked slong the orthochemics of
crystal forstarite shocked slong the orthochemics of
states for both directions are well described by
single current latter a decided along the first
states for both directions are well described by
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orystal forstarite abooked along the 5 and o
pressures in excess of 100 Gen. Earlier data first
prassures in excess of 100 Gen. Earlier data first
behavior in the sixed-phase region from 65 to 27.
Thus shock-loaded forsterite is sent compossible for
the both six in the sixed-phase and life-pressure was
above 50 Gen. The present results represent to
the depend on crystal orientation. Theoretical Seminito depend on crystal orientation. Theoretical Seminito depend on crystal orientation. Theoretical Seminito state-oriental data are assentially fessions of
recent experimental data are assentially fessions of
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reason suggested with the 3-vois experimental six
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6160 Phase changes
THERMAL CONDUCTIVITY OF MINERALS AT HER PLANGES
THE BFFECT OF PHASE TRANSITIONS
Rouforme, M.C. (Smithaonian Astrophysical Operating changes
Theory predicts and measurements confluent that enteresting the confluent control of the such as the justice thermal expansion generally decrease in plantes increasing density upon compression of solids. The Deliver and increasing density inpon compression of solids. The Deliver are constitution model factor products a deconfluence model factor products a deconfluence model factor in the control of the such a such as the control of the such as the control of the such as the control of the such as the s

Basseky, J.B. Bolbers, A.L. Broadfoot, B.R. Indal, J.C. Beckensil
The temperature and composition of the upper steephers of Saturn have been inferred from forpast 2 ultraviolet spectroseter constitution saturatements and by observing the sun and the star b-Boorpil while they were being committed by kitars. The observations analyzed here provide steephers parameters from 2900 km down to 950 kbors the 1-bar level referred to the equator. The temperature in the model simulation of the date is 420 ± 50 K down to short 1600 km. Below 1600 km. Below 1600 km the temperature decreases with a variable light rate down to 130 ± 40 km. A constant temperature at 120 K is applied in the model for the region of the methane homopause down to 950 km down to short 1500 km. A constant temperature at 120 K is applied in the model for the region of the methane homopause down to 950 km down to short 1500 km, giving down time of 950 km down to short 1500 km, giving down time of 95, 1-1,0 x 100 cm<sup>-1</sup> and [H] ~ 5.5 x 100 cm<sup>-1</sup> nm to Clama the subsect at 2500 km. Many the methane losspasse the H, density in [H<sub>2</sub>] = 1.2 x 101 km cm<sup>-1</sup> in the CR, number down ity sixing ratio of 4,0 x 10-4. The oddy diffusion conficient in the vicinity of the methane homopause is estimated to be ~5.0 x 100 cm<sup>2</sup> s<sup>-1</sup>. The atomic lydroge density profits suggests at downward H lydroge density profits suggests at downward H, Copplys, Res., 51ue, Paper 34005

SIG Armospheres of Planets

UMARGE 2 ONSCRATIONS OF SATURM'S MID-LATITUDE CLOUD

TRAUBERS ROMPHOLOGY, MOTIONS, AND EVOLUTION

LA. STURMYSKY (Speca Science and Engineering Conter,
Iniversity of Visconsin-Madison, Madison, Misconsin,
Sirok, St. Exercrowsh R.J. Fraues, and V.E. Suomi
Both Saturn's large-scale cloud bands and the
distribution of its local cloud leatures have a
characteristic sonal organization. The latitudes
trauses 10% and 45% contain two oppositely directed
just to close proximity, with many bright, acrive
fasters in the westward jst, and an unusual ribbonlike wase leature encircling the planet in the
setward jet. Saveral of the smaller features within
the westward jet do not remain at fixed latitudes,
ci lateract with each other. One group of v-shaped
fatures to found to have periods of high activity
torrelated with the passage of a cyclonic bright spot.
The ribbon wave was Fourier asslyzed to determine its
vactual composition. The Steatest power is mast
varamcher nine, with significant additional pasks
(paring at planetary wavenumber 19, 22-77, 35-38,
ci 47-51. The phase velocity increases with
tamenames, but is not wail-described by a Rossbytarroute disparsion relation. The curvature of the
Men wind profile obtained from cloud tracking
ticates that the weatward jet accessed the standard
laterically accessed the deep-circulation
latability condition of Ingersoil and Pollard
licates, 22, 1982). The ras addy velocities on Saturn
to less then half as large as thems observed on
lyites. (Saturn, cloud morphology, atmospheric
circlastion.)

J. Coophys. Res., Slue, Paper JA1036

. Ceaphys. Bas., Blue, Paper 3A1036

CHIP Atmospheres of Planots

The REACTION MR. + PH. - NH. + PH. | NH. + PH. |

The REACTION MR. + PH. - NH. + PH. |

THE ATMOSPHERE OF JUPITED

TO CORNER HAS UNDERT AND THERE OF JUPITED

3. 1. Boso. W. D. Brobst. D. F. Hava and L. J. Stief

16. Stope Flight Center, Astrochemistry Brench,

Corobelt, Maryland 20771)

It has been suggested that the photochemistries of NH. |

12. Hilled in the upper atmosphere of Jupiter.

13. While the reaction MI. + PH. + NH. - PH. would,

14. The rate were fast enough Et Jovéns attrompferio imperatures, regenerate ammonis in the upper atmosphere is the same time accelerating the decomposition of Cophins. The absolute rate constant for this reaction whe has necessared over the temperature interval 218-456 viag the bedwidge of flash photolysis—Janer induced flurameness (FF-LIF). Mr. redicals were produced by flurameness (FF-LIF). Mr. redicals were produced by flurameness (FF-LIF). Mr. redicals were produced by sultimenting techniques. At each of the five temperature interval 218-456 viagness apployed in the study, the results were shown to be constant results are best represented for 218 5 T < 100 pt. re also discussed theoretically and the implications to also discussed theoretically and the implications tooldered for models of the photochesistry of the temperature of Jupiter. Since we now find that the rate creates for the reaction Mi. + Mi. + Mi. is two retra of wagnitude alower than redurred in this model, it contribution to both the recotion can make only a negligible ecomposition of Mi. in the recotion of Mi. and the decomposition of Mi. in the upper atmosphere of Jupiter J. Sechhya. Ess. Green and the prophys. Ess. Creates and the second problems of the contribution of Mi. in the upper atmosphere of Jupiter J. Sechhya. Ess. Creates and the contribution of Mi. in the upper atmosphere. Goophys, Res., Green, Paper 301140

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AND STRILL ADDOPPEREN FROM THE VOYAGEE 2 MAY BOLAR

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Planetology

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6975 Surface of Plainte SPECTRAL PROPERTIES OF MINIUMES OF MONTHORILLONITE AND DARK CARBON GRAINS! DEPLICATIONS FOR REMOTE SENSING MINERALS CONTAINING CHEMICALLY AND PRYSICALLY ADSORBED

MARK CARBON GRAINS: DEPLICATIONS FOR REPOTE SENSING MITMERALS CONTAINING GRENICALLY AND PRYSICALLY ADSORBED MATER
R. N. Clark (Planetary Geoscionees Division, Hawaii Institute of deophysics, polywretry of Hawaii, Roncluiu, Rawaii, 96822)
The spectral properties from 0.4 to lym of montmorfillonite plus dark carbon grains (called opeques) of various sizes are studied as a function of rhe weight fraction of opeque material present. The reliectance level and band dapths of the 1.4-, 1.9-, 2.2-, and 2.8go water and/or OH absorption features are analyzed using derived empirical relationships and scattering theory. It is found that the absorption band depths and reflectance level are a very mollinear function of the weight fraction of opeques present but can be predicted in many cases by simple scattering theory. The 2.8-am bound water fundamental band is the worst difficult absorption feature to suppress. The overtone absorptions are suppressed a greater amount than the fundamental but are attil sperson even then 10-20 will opeques are present. Thus the band depth ratio of one overtone by line fundamental or to mather lower evertone varions as a function of the weight fraction of opaques present. The relationships observed, and the simple matering theory presented show that quantitative compactional remote sensing studies are fusable for surfaces containing complex mineral attature of this cort. The question of the uniqueness of quantitative remote sensing is discussed.

J. Geophyn. Pes., Ped. Paper 181065

6575 Surface of Planeta
SATURN'S SMALL SATELLITES: YOYAGER IMAGING RESULTS
P. Thomas and J. Yeverha Laboratory for Planetary
Studies, Cornell University, Ithaca, N.Y. 14853),
D. Morrison, N. Davies, and T. Y. Johnson
Yoyagers I and 2 provided images of sufficient
resolution for morphologic and photometric studies of
Saturn's small satellites. These objects, all very
difficult to observe from Earth, orbit Saturn at distances of 2.3 to 6.3 Rg [just outside the A-ring to
the orbit of Dione) and range in man diameter from 22
to 188 km. All are irregularly shaped (long/short
axis ratios range from 1.4 to 2.0) and probably
heavily cratered. While impacts have apparently been
important in shaping these objects, observed crater
densities suggest that the present forms may have survived for about 4 billion years. Geometric albedos
vary from 0.4 to at least 0.6. These albedos and the
few color data available are similar to those of
larger Saturn satellites which are known to have surfaces made predominantly of water ice. The range of
observed albedos could be explained by alinor variations in the downth of drk, opaque contaminants.
(satellites, surfaces, Saturn)
J. Goophys. Bea., Rad, Paper 380389

kophys. Res., Rad, Paper 380589

adouracion on the order of a kilometer or better.

6599 Guneral or Hiscellements

No Hiscellements

OF THE ICY SATELITES

L. J. Lanzaratti, C. G. Haclennan, W. L. Brown (Ball
Laboratories, Murray Hill, N.J. 07974), R. E. Johnson,
L. A. Barton, C. T. Rejmann, J. M. Gerrett, and
J. W. Boring (Bepartment of Nuclear Engineering and
Engineering Physics, University of Virgista,
Charlottasville, Virginia 22901)

The possible production of a neutral particle "torus"
by magnetosphere particle sputtering of the [cy satallites (Exceledus, Tathys, Dions, Rhea) of Salurn is
discussed. Particle spectra from the Voyager Low Energy
Charged Particle experiment are used together with
buttons for the ajected spacles. An extended torus
region in the finner asgentosphere of Saturn is expected,
with MgO escape fluxes in the vicinities of the satallites varying from 2 to 7x10 mol/cg\*/sec for incident
protums and from 36 to 14x109 mol/ca\*/sec if the
protums are all oxygen. (ice sputtering, Saturn,
magnetosphare particles).

MAGNETIC DRIPTS AT 10; DEPLETION OF 10 NEW ELECTHONS AT VOYAGER I ENCOUNTER DEE TO A FURBIDISM COME. B. E. Coldstein (Let Propulation Laboratory, Cattfornia limitura of Technology, Pasadons, California, 9109), and W.-H. ip

The possibility that the partial drop-out of the 10 May departons observed at Voyager I encounter with 10 might be explained by a forbidden sque is investigated. Because the convection velocity is the vicinity of 10 decrease, grad 8 drifts of emergatic electrons opposing the convection reads: in a forbidden region around to. It is found that the location and magalitude of the 10 New electron deplainton calculated on this basis agrees well with the location countered to this basis agrees well with the location found by sapping along draped field lines from the Voyager trajectory to the location of Information of 10 MeV electron thus should not be construed as evidence for a local dipole magnetic field at 10. If the forbidden some explanation for the 10 MeV drop out observed by Voyager is correct, than no electrons in this energy langs would be lost, to the surface of 10 and there should not be a wake to the surface of 10 and there should not be a wake to the surface of 10 and there should not be a wake acted to the first of the forbidden some explanation for the V was observed by Plonest; an apparent discrete field had penaturated data is consected field (higher ratio of Alfven laws condectance, to I condectance) during the Plonear period than during the voyager ancounter, partials, losses for cold be sublimed by precipitation at its. Losses for both assegatic alsections and protone at Te ere believed by Plonear period and analysis of the sublimed of afferent sevents by leasering field and condectance. Such afferent sevents be electric, field shielding at Inc. (In secands)

Seismology

6950 Scientic Sources

EARTEGOARTS IF THE ORDZCO FRACTURE ZONE: SRISMICITY,
SOURCE HECHANISMS, AND TECTORICS

A.H.: Trebu (HITYMOID Joint Program in Oceanography,
Cambridge, MA 02139; now mi U.S. Geological Survey,
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J. Geophys. Pes., Rod, Paper 3B1055

6950 Solamio Sources (Nachanisms)
SYSTEMATIC CHANGE OF FOCAL MCCONTEN WITH DEPTH IN THE
MESTERN GRANT RASIN
U. R. Vetter and A. S. Syall (Selsmological Laboratory,
iniversity of Newsda, Rano, NV 69557)
For most areas in the western Great Rasin focal
mechanisms show a consistent pettern of primarily
strike-slip notion for shallow events and oblique or
normal slip for deepst syemis. However, orientation of
the axis of least principal strees (Teasis) is different for different areas; NN-SE for western Newsda
and the Hyno Lake region, and NS-SE for the Namoth
Lakes area. Along the remainier of the Sierre Szwala
frontal fault zone, T-asss show both orientations.
In general the change in mechanism with depth is interpreted as the result of increasing overturbon pressure, resulting in rotation of the maximum compressive
atreas (P-axis) from horizontal at depths less than
about 6 but to vertical at depths greater than about 9
km. The absence of normal-slip events at depths
greater than 10 km in one area (Fron-Excelsion-Luning
sche) say be explained by a larger horizontal outpressive stress compared with areas that do have normal
faulting at such depths. In some areas conjugate
right—and left-lateral shear on meanly variation fractures may be associated with the formation of clusters
of magna-filled dikes at shallow depths.
Assuring strike-slip faulting to be characteristic of
earthquates with depth less than 6 km and normal faulting for events deeper than 10 km, extragolation of
the crust provides a rough estimate of the maximum and
ministen principal stress in the upper few kilometers of
the crust provides a rough estimate of the maximum and
ministen principal of the ure rough principal stress
is vertical and e-pai to the overturion pressure, about
250 Mm; the subminum stress is horizontal and about
260-200 Mm.
J. Caphys. Ras., Fed, Paper 381077

6970 Structure of the crust end upper mastle
FABTRQUAK LOCATIONS AND THREE-DIMENSIONAL CRUSTAL
THECTURE HOTHE COTTE LAKE AREA CENTRAL CALLFORNIA
C. R. Thurber (Department of Earth and Space Salences,
State University of Sew York, Stony Brock, N. Y. 11794)
Previous work on the staultaneous invarmion mathod
has been approved and extended to incorporate iterative
solution for earthquake loositions and laterally
heterogeneous structure. Approximate ray tracing and
parameter appraction are important elements of the
improved method. Application of the method to P-wave
arrival time data recorded by stations of the US
declogical Eurrey Central California Matwork yields a
three-dimensional model for the valocity atructure of
the upper crust in an area encompassing the rupture
zone of the Coyote Lake earthquake of August 1979.
Yery strong correlations between the valocity model and
the geology and gravity and magnetic anomalies are
observed. Improved estimates of the locations of
earthquakes in the study area are slee determined. The
relocation of explosions indicates epimentrel
accuracies on the order of a kilometer or better.
Hased on the revised hypometral locations, it is
concluded that the Saa Andrees Fault in vartices in
this area, with no notual offset between the epimentres
and the fault trace. In contrast the Caladrane has two
(or more) active fault zurefaces, one meanly vertical
and another dipping 790 to the cartheast.

J. Geophys. Eas., Eed, Paper 181076

amplitude ratio siximum is the statement and applitude ratio of the sound to be a localized feature, apparently produced by an asplitude anomaly in the direct 3 phase, and therefore need not reflect the velocity gradient at the base of the sample. The amplitude ratios that are free of this supesly are consistency with calculations for the JB model or models with mild possitive or ongestive velocity gradients in the liverwoost 200 he of the mental. Sets arrivals are particularly namelies to the sheer velocity structure just above the core-ments boundary. The apparent sprival time of SchW is as much as a second greater than that of SchW is as much as a second greater than that of SchW in the distance range 75 to 80 for feat of Okhanek avents vecorded in Borth America. This can be explained by interference affects produced by solutioned by interference affects produced by elecalized high velocity leyer or percon positive 5 we valoaity gradient in the lowermont 20 he of the sameton a velocity increase of rhoot 32 is required to explicit the observed which between SchW and SchH. This thigh velocity layer varies laterally, as It is not observed in similar data from Argentine avents. Maries astimates of the outcoment over P velocity structure are displained by modeling SKR signals in the distance range 75 to 85.

J. Gnophys. Res., Red., Mager JBH110

Geoghys. Seet., new part states below the upper manule REPLECTION PROPERIES OF PILASE-TRANSITION AND COMPOSITIONAL-CHANGE MODELS OF THE 670-KM DISCONTINUITY AC. Less (Department of Geology and Geophysics, University of California, Bertigley, California 94770, M.S.T. Budrowinstit and R. Iscarlost. Salamic observations of the emplified rates usp. P67097 seep. P7 staggest a subscript coefficient R. — 7-1396 for reflections from the underside of the 6711-8111 disconduisty. The can be compared with attended reflecting coefficients are constrain the manula of the minute translation region were belonging under the first strongs, the translation region were belonging to the days of the first strongs the translation region when the strong the first strongs the translation produces and formation of the first strongs the translation produces the first strongs the translation produces the region were coefficients from the phase invasions pertinent to the 676-km discipationity are less than 1.9%. These places ignorables produces their sustaining R If they are affectively discussionates, which there R.—2-19, accept for the garner to percentage the familier manulation are the first first the garner of the paramet to percentage the familier manulation and the first R.—2-19, accept for the garner to percentage the familier manulation and the first R.—2-19. Let general, given

Chinese Geophysics

Volume 2, Numbers 1 and 2 Earthquake Research in China: 3 Earthquake Research in China: 4 Francis T. Wu, editor

Translated articles and selected abstracts from Acta Geophysica Sinica and selected abstracts from Acta Geophysica Sinica and Acta Seismologica Sinica plus contributed papers and a table of Romanization (Pin-Yin and Wade-Giles) Research focuses on both short and long term earthquake prediction in China. Covers fault displacement, crustal and upper-mantle rosuarch, abnormal animal behavior as short-term earthquake procursors.

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to detro, introduces controlly agency is phase from from the charge material frequency must mean record over a region less, then 3-km than the kind to be on the order of 5 × 4 decontinuous strange in chemical composition at 50 km depth, coupled with a charge in phase can also groundly a reflection coefficient of the observed negational R × 2.3 for a that order charge in phase at 6.0 km with different tool concentrations on each side of the decontinuous, and R × 4.6 for cases with a discontinuous increase in suba content. Based on our analysis, the thermal and chemical boundary layers which would occur active such a chemical discontinuous would probably have negligible effects on the chemical discontinuous would probably have negligible effects on the chemical discontinuous knowledge and composition at 500 km.

J. Geophys. Pen., Ped, Paper 381969 **Social Sciences** 

7310 Ecoronics
ALTERATIVE STRUCTURES FOR WAYER RIGHTS MARKETS
J. Wayland Shaark (Department of Chvil Engineering,
University of Illinois, Urbana, Ellinois 61801)
and Randsjah K. Lyon
The design of systems of marketable permits for
vater consumption from natural watercourses is
examined. For the work reported upon here, the
wost important considerations are those seed ated
with: 1) occartainty of future atreamflows and
accounsic conditions, 2) locational issues, and 1)
efficient and effective functioning of the
markets. Particular attention is given to the
problem of implementing marketable rights systems
in regions presently following the riperion
doctrium. In these regions the most important
design decisions includes the basis of definition
of perwits, the means for initially distributing
them, the type of maybet mechanism need for their
transfer after they are issued, and the
restrictions placed on their use and transfer.
These design decisions are examined here with
respect to program objectives including; sconomic
efficiency, equity, mass of administration and
implementation, and maintenence of instream flows.
Alternative approaches to the design problems are
discussed and transfer-lighted by the decisions
are identified.

Vator Besour, Boss., Paper 190652

Solar Physics, Astrophysics, and Astronomy

7720 (Electromagnetic Radiation)
THE SOLAR ABSOLUTE SPECTRAL IRRADIANCE AT 1216 A AND
1800-3173 A: 12 JARNANY 1883
U.H. Mount (Laboratory for Atmospheric and Space
Physics, University of Calarado, Boulder, CD 80399),
G.J. Rottean
The full-disk solar spectral irradiance in the
spectral range 1800-3173 A and at Ly m was obtained
from a rocket observation above Mitta Sands Kisetie
Range, New Haxico, en 12 January 1903. Comparison
with measurements mede in May 1902 show no changes
within the absolute errors of the experiment. The
absolute calibration of the Instruments for this
flight was accomplished at the Mational Burgay of
Steedards Synchrotron Radiation Facility.
J. Geophys. New., Green, Paper 200941

J. Gaophys. Bon., Green, Paper 20041

FIG Summonts (Prediction)

The Wischal Admond as a Particition of Solds Activity

H. M. Silverman (Physics Department, Sension Collage,
Chastent Sill, MA, Oziby)

Acrycal occartences frequency may be used as proxy data
for solar sativity. In recent years magnetic data and
sureral data during the decilining phase of one summent
syple have been used to predict the marisum acceptations of the following cycle. This paper discusses
appropriate use of sardral data for this purpose, and
tests the walldigt of such a procedure for the period
1721-1943. The results show that the ass of suporal
sums for sumspot mislams and the proceding three years
can predict the subanquent sumspot misher marison, but
that he predictor involves two branches. One, firting
the usjority of observations, may be considered the
stormal branch. The other, called herrs the defict
branch, gives fewer surporal occurrences then would be
expected. Treatment of magnetic activity data in the
same fashing gives similar, but not identical respits.

(somspets, surered, solar settlying prediction).

J. Gaophys. Ess., Blue, Paper 140713.

edary at about hm., . Geophys., Res., Blue, Paper 140905